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The Geographical Journal

Vol. LXIII No. 4 April 1924

THE ROCKS AND MONUMENTS OF PETRA

Sir Alexander Kennedy, F.R.S.

Read at the Meeting of the Society, 14 January 1924. Air-map follows p. 368.

AFTER an uninterrupted slumber of more than six centuries, Petra was brought into the knowledge and wonderment of travellers by Burckhardt's daring adventure * in forbidden places in 1812. He reached the site of the ancient city—disguised as an Arab—with great difficulty, and was compelled to leave it without exploration after a stay of only a single night. This however was sufficient to convince him that the place he had visited was really the Petra of story. His tale excited other wanderers, at first few, but in the latter part of the last century fairly numerous. Very few of them indeed were able to remain there more than two or three nights, and although many published their experiences, practically nothing of scientific value resulted from their visits. An artistic exception, however, must be made for David Roberts,† who in 1829 was able to spend there sufficient time to make the beautiful drawings which he afterwards published. His fourteen drawings of Petra are, on the whole, wonderfully accurate so far as the monuments are concerned, although entirely conventional as to the rock scenery. The accompanying text is, however, valueless.

For nearly a century the various travellers who published their experiences seem to have been more interested in what they called the "fulfilment of prophecy" than in any other matter; indeed many of them have clearly experienced a sort of holy pleasure in viewing the desolation of countries whose inhabitants had been cursed and massacred by the holy people. Oddly enough, many of them ‡ seem to have been under the impression that the "desolation" had existed continuously

* 'Travels in Syria and the Holy Land,' by the late John Lewis Burckhardt (Murray, 1822), p. 420.

† 'The Holy Land, Syria, Idumea, Arabia,' etc., from drawings made on the spot by David Roberts, R.A., with historical descriptions, etc., vol. 3, 1849.

‡ The poem on Petra by Dean Burgon, immortalized by the much-quoted description: "A rose-red city—half as old as Time," has however for its argument the way in which Divine Providence destroyed a *Roman* city in the sixth or seventh century A.D. because of a quarrel between two Semitic tribes two thousand years earlier.

since the time of the Israelites, and had not been interrupted by a thousand years of continuous success.

Anything like a scientific examination of the city and its monuments, and the story which they have to tell, only began to be undertaken a quarter of a century ago. Prof. Musil* (now a Professor at the Czech University of Prague) was the first real explorer. He visited Petra in 1896–8, and subsequently published a valuable account of it in the second volume of his 'Arabia Petræa,' with some good photographs and also the first map which possessed any value.

Two German professors, Brünnow and Domaszewski,† along with Prof. Euting, visited Petra in 1897 and 1898, with a large party of assistants, including surveyors. They made a general map, which remains the best in existence, as well as eighteen detailed maps, mostly on a scale of 3/10,000, on which they marked the approximate position of some eight hundred and fifty tombs, temples, inscriptions, steps, etc. The contouring of the maps, unfortunately, has largely been guesswork. Their book contains a more or less descriptive list of their whole eight hundred and fifty "monuments," with very complete notes of the comments of older visitors of every nationality. There are naturally some mistakes, and certainly a great many omissions, in their list. But taking the work as a whole, and considering the time within which it had to be carried out, the work of these investigators was splendidly done, and is absolutely invaluable to any one attempting now to explore Petra. To the credit of the writers is also the generous way in which they always acknowledge the work of their predecessors.

A few years later Dalman‡ published in 1908 and 1912 the results of no less than six visits which he made (in every case with a large party) in years from 1904 to 1910. His object and that of his colleagues was to study the "holy places" of Petra, and everything connected with the religious cult of the Nabateans, and this they did with considerable thoroughness. The immense difficulty of covering the whole ground, owing largely to its natural formation, may be guessed at by the fact that in three weeks of general exploration last year I came across five "holy places" which had not been noticed by Dalman, and I do not doubt that there are many more. The irregularity and roughness of the ground make it extremely difficult to cover every square yard of some 6 or 8 square miles; but nothing less would be necessary for any investigation to be entirely exhaustive.§

A short visit to Petra in 1922, which the courtesy of the Amir 'Abdullah and the cordial help of Mr. Philby enabled me to make, left me so

* Alois Musil, 'Arabia Petræa,' vol. 2: Vienna, 1907.

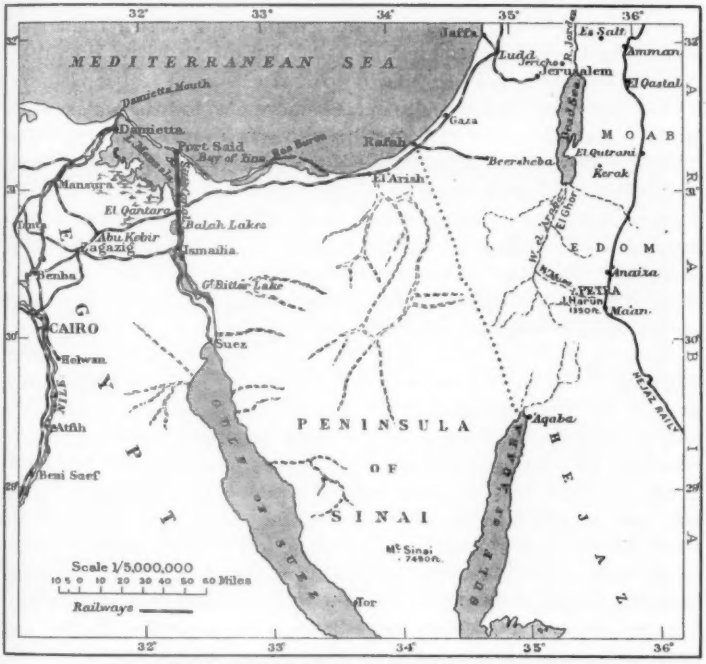
† Brünnow and Domaszewski, 'Die Provincia Arabia,' vol. 1. Strassburg, 1904.

‡ Dr. Gustaf Dalman, 'Petra und seine Felsheiligtümer' (1908), and 'Neue Petra-forschungen' (1912). Leipzig.

§ Dr. Dalman, unfortunately, does not imitate Brünnow in his treatment of those who worked before him, and on whose work he had largely to build.

fascinated by the place that I was only too glad of an invitation from the Amir, again most kindly arranged by Mr. Philby, to go there last spring at a time when the Amir would be there in his Summer Camp. In this way I was able to spend three consecutive weeks in the Wadi Musa. In this time, with the advantage of the knowledge of the detailed work of the explorers whom I have mentioned, it was possible to see much, and this paper represents some of the results of my visit.

As to Petra itself, it is a place so insignificant on maps that it may be useful to define its position It lies in lat. 30° 20′, and is therefore



Sketch-map of Petra and surrounding country.

almost exactly due east of Cairo, from which it is distant about 250 miles. The site of the city is about 20 miles east of the Ghor—the southward continuation of the Dead Sea rift—and is about 120 miles south of 'Amman, now the capital of Transjordania.

Supposing all arrangements to be made beforehand, Petra can be reached in about eleven days' hard going from London, *viâ* Marseilles, Port Said, El Qantara, and Jerusalem. From Jerusalem there is a motor road, quite good for a great part of its length, which takes one by Jericho and Es Salt to 'Amman in about five hours. The railway journey on the Hejaz line from 'Amman to 'Anaiza or Ma'an takes some eight

or ten hours. The line runs nearly due south, through the western part of Transjordania, which is cultivated and agricultural as far as El Qutrani. Thence southwards the country is limestone desert dotted with scrub. It is a dry and desolate rolling plateau with occasional patches of what look like broken basalt blocks, but sometimes turn out to be blackened limestone. In the southern region one occasionally sees hills, and in particular one great cone away to the east impresses one as if it were a 12,000-feet mountain, although probably it may not be more than half that height; I could not find any one who knew either its name or its position. The general level is about 2500 feet above the sea, gradually rising to 3500 feet at Ma'an, and higher still to the west. The air was pure, bright, and delightful in March and April when I have been there, and the desert surface being fairly hard there are no real sandstorms.

Doughty* says a good deal about the mud-walled town of Ma'an, which in the years both before and after his visit was a very usual jumping-off place for Petra, which was reached from there on horse or camel back. A fortified mud-brick house in Ma'an which I photographed shows a form of equiangular zigzag decoration which is also to be seen further south at El Khureibeh (Doughty's el-Khreyby), and has been found on a carved stone discovered there and dating probably from Roman times,† while it is common in Assyrian decorations of 600 to 700 B.C.—a strange case of local persistence of a small detail covering nearly 3000 years.

The 20 miles of route from Ma'an to Petra lie along featureless valleys with no views over their high banks, but mostly with a certain amount of cultivation, until the village of Elji is reached.‡ Here the valleys open up, and a first very striking and really beautiful view of the Petra hills with Jebel Harun behind them, which according to tradition or legend the Crusaders took for Mount Sinai, is obtained. The soft, ugly, rounded, blister-like surface of the "white" sandstone shows itself sharply distinct from the angular outlines of the harder red sandstone with which it is very much inter-stratified. Finally, the track descends steeply from the desert to a level of about 3400 feet, where it enters the much-talked-of gorge through the sandstone, Es Siq, and eventually reaches Petra at a level of about 3200 feet.

Ma'an is east-south-east of Petra. Last year Mr. Philby worked out an improved route starting from 'Anaiza, a station on the Hejaz line about 18 miles north of Ma'an, and north-east from Petra. From this point a passable road once connected with a branch railway line (which I understand was made by the Turks during the War, for the conveyance of timber), leads to Ras el Ghor, where the limestone desert breaks off in its western escarpment. This route over the desert is more open and more interesting than the route from Ma'an; for some miles it even runs beside

* C. M. Doughty, 'Arabia Deserta,' vol. 1, pp. 32 *et seq.*

† Jaussen et Savignac, 'Mission Archéologique en Arabie,' vol. 2, p. 49.

‡ Burckhardt, p. 420; Doughty, vol. 1, ch. ii.

1. A SUNNY OPENING IN THE SIQ

2. TWO MUCH-WEATHERED TOMBS OF "EGYPTIAN" TYPE ON THE NORTH-EAST WALL

3. ED DEIR

4. VIEW EASTWARD FROM PLATEAU OF ED DEIR

The horizon is the westward escarpment of the desert : below is the light-coloured sandstone on the upper part of El Hupta.

El Biyara

The Acropolis

Entrance to Gorge of Ed Deir

5. THE OPENING OF ES SIYAGH

a pleasant little river full of water in April, and for a long way along valleys apparently only recently denuded of trees. A final pull up a rough steep slope covered with stones brings one suddenly in sight of the Petra region in a fashion never to be forgotten. The great limestone desert plateau—which extends to within 15 or 20 miles of the Dead Sea rift—ends here in an abrupt escarpment, not precipitous, but generally too steep for horses to face directly, at a level of about 5500 feet. Westward of the escarpment the limestone has disappeared, and left exposed a great band of "Nubian" sandstone, probably 10 or 12 miles wide, its upper surface some 1500 feet lower than the desert level, between the escarpment and the final drop into the Ghor. It is in this sandstone that the Petræan monuments are carved. I understand that geologists consider it to belong to the Lower Cretaceous level, if it is not of even earlier date, but that in different parts of the Hejaz–Egypt region it may well be of different ages.

Looking west and south from the escarpment over Petra itself one sees Jebel Harun, according to Moslem tradition the Mount Hor of Aaron's burial. Beyond this comes the great hollow of the Wadi 'Araba, on the further slopes of which the Idumean Hills seem to shimmer in the sun, as full of lovely indescribable colours as are the hills of Moab seen on a fine evening from the Mount of Olives.

From this view-point, as from above Elji, one can see how the sandstone formation, although the whole of it goes by one name, divides very distinctly into two sections. The "white" sandstone looks always as if its surface were a conglomeration of huge bladders, great rounded masses, somehow offensive and repellent in appearance. The sharp picturesque outlines of the red sandstone apparently lie beyond it. In fact, although there is a great mass of white sandstone which lies bodily to the east of the typical Petræan red variety, yet all over the area of Petra the two seem to be mixed and inter-stratified quite irregularly. One sees time after time in the monumental façades how very much softer the white stone is than the red, and how very much more it has decayed.

After a couple of hours on horseback along a fair and certainly a picturesque track, the route from Ras el Ghor joins that from Ma'an just where it runs into the sandstone region, below Elji, about 3 miles east of the centre of the ruined city, in the deep hollow of the Bab es Siq—the Gate of the Siq.

The still fertile region of Elji drains from east to west by the Wadi Musa—so called, of course, from the Mosaic legend of the Striking of the Rock. The river, which once apparently was perennial, now only runs through Petra itself for a time in the winter. The great mass of sandstone between the foot of the Bab es Siq and Petra runs up to about 3800 feet. Through this mass, by what must have started as a natural rift, the river has found its way in a narrow winding gorge, sometimes less than 20 feet wide, often entirely overhung by the cliffs beside it,

having at every one of its numerous bends something new in impossible picturesqueness (Pl. 1). The river was once so considerable that in very early times it was diverted from the Siq through a long tunnel which delivered it into a ravine running northwards, and so eventually into the Wadi Musa near the centre of the city.

Near its entrance the Siq was once spanned by a lofty Roman arch, which however fell down in 1896. Different visitors have been equally certain that this arch was, and that it was not, an aqueduct. The balance of evidence is probably against it.

Remains of Roman paving as well as water channels show that the Siq formed a much-used approach to the city from the east for centuries.

In openings here and there one gets a glimpse of sunshine, only to be eclipsed immediately by the rocks closing in and even curling over, until suddenly, turning a sharp corner, the Temple which the Arabs call the "Treasure House of Pharaoh" (Khazna Fur'un) suddenly blazes out as if it were a thing of fire, with an effect which no one who has ever seen it can forget.* The Siq then widens and turns northward to reach the open, after which the bed of the Wadi Musa turns again westward and crosses a great open space about a mile wide, between east and west walls of sandstone rock, before it finds its way by another very narrow ravine, Es Siyagh, through the western wall westwards and northward. This western ravine is said shortly to become inaccessible, but apparently no one has ever really verified the fact. As it contains many graffiti and votive inscriptions, just as the Siq does, one is tempted to think that it may at one time have been part of an east–west route, although it has been unused for centuries. This point certainly requires investigation.

The City of Petra itself, first Nabatean and then Roman, lay in the open part of the valley just mentioned. In early times great trade routes east–west from Persia and northern Arabia to Gaza and the Mediterranean, and south–north from 'Aqaba to Damascus, crossed at or near Petra itself. Its two great sandstone walls, in or on which the Petræan monuments are carved, run roughly parallel to each other in a general direction north-east by south-west, and lie more or less a mile apart. The Aeroplane Survey (see map) made at my suggestion by the courtesy of General Tudor, shows how both walls are traversed by innumerable ravines, mostly very narrow and having a general direction from south-east to north-west, diagonally across the valley, cut by wider wadis running almost due north. The air-plane view shows also very distinctly the lines of the Roman streets and the outlines of some of the principal buildings or places, and many other points quite unrecognizable on

* It ought to be mentioned that, although the Petræan sandstone certainly shows often a beautifully marbled condition of coloured stripes, the "rose-red" colour of the great masses of rock is only striking when specially lit up by the sun. At ordinary times and in normal lighting the main colouring of the rocks is a dull purplish-red.

the ground. All the drainage from both walls finds its way to the Wadi Musa, so that the central region between the walls is anything but level; in fact, its covering of *débris* and rough vegetation and the dip of the cross wadis which carry off the water (when there is any) from the upper ground, render walking over it very tiring and laborious, and riding hardly less so.

On the western side of the opening of the Siq * there stands a great promontory, forming part of the south-east wall, known to the Arab as Zebb 'Atuf, and by various other names in different languages. On its narrow northern end is a very impressive Sacellum—a place of worship and sacrifice. South of this come the remains of a built fortress, once well guarded, while on the southern end of the promontory, along with worked stone places of uncertain purpose but carrying very many votive inscriptions, stand two rough obelisks, some 20 feet high, of unknown purpose or intention. From these it may be convenient to call the whole promontory the Obelisk Ridge (Pl. 12) At the foot of the ridge on the side of the Siq is a great hollow, partly artificial, in which has been carved out in Roman times a theatre capable of seating several thousand persons. Around this and opposite it, in the wide estuary of the Siq, are hundreds of tombs, as well as non-sepulchral monuments—mostly of the older types—while northward lies the north-east wall containing four or five of the chief of the later classical monuments, and honeycombed by a number of "holy places."

Across the mile of clearing between the sandstone walls lay the Roman city—before its time the Nabatean city—before that possibly an Edomite settlement; we do not know. Only skilled excavation can tell us the story, and as yet there has been no possibility of this. The ancient river in and before the time of the Romans had been large enough to require the building of retaining walls on each side in many places, and a considerable length of it had even been arched over. The steep sloping banks on both sides of it are now covered with *débris* of ancient buildings, half hidden in a scrub vegetation, remains which must cover roughly about a square mile. Only a single *built* building still stands —a Roman temple close to the western exit of the stream from the open ground into the Siyagh ravine, near which we made our camp. The temple would be interesting, as are a good many other Roman remains, were there not in Petra so many things more interesting, more ancient, and much less familiar.† Beyond the Roman temple stands an isolated rock island known as El Habis,‡ some 200 feet high. (It has

* The Siq turns *northwards* at its opening, as mentioned above.

† Mr. Philby unearthed below the Urn Temple a fine Roman vase, quite uninjured. It is about 2 feet diameter, 18 inches deep, and 2 inches thick, and has two ears and a hole in the bottom like a huge flower-pot.

‡ The name of El Habis on Brünnow's map is in error placed on the much larger mass of rock to the west known properly as El Biyara.

generally been called by travellers the "Acropolis," but for no adequate reason.) There is an ancient place of sacrifice on it, as well as, on a higher point, the remains of a watch tower, possibly mediæval.

The complex mass of narrow valleys northward from this point (Pl. 6) is covered, as to sides, bottom and ridges, with monuments, while far to the north-west and on a plateau about 700 feet above the valley, is a huge temple façade of classical design known as Ed Deir, probably standing on or close to the site of an older place of worship (Pl. 3). Votive inscriptions and other signs indicate that this locality was a sacred one, probably from before Nabatean times well into the time when the Christian religion was recognized over the Roman Empire.

The ravines in the north-western wall are sometimes as narrow and forbidding as the Siq itself, but they are steep instead of being nearly level. The passage of the Deir gorge is, however, made comparatively easy by flights of steps hewn out of the rock for the convenience of faithful worshippers of Dusares, and in this case serving for Christian pilgrims also in later times.

To the south-west behind El Habis, the wall of El Biyara (Pl. 5) is covered with monuments so numerous and so close together that the natural and artificial faces of the cliff can hardly be distinguished from one another. Southward from the Wadi Musa, the rough slopes of the open ground stretch upwards to a watershed some 3 miles away, over which the blunt points of Umm et Telg are visible, and a conspicuous point at the southern end of the east wall—Jebel Nmer—has on its summit a holy place reached by Dr. Dalman (Pl. 7). Far away to the east, in every view, the high escarpment of the limestone desert overtops everything.

On the east side of the site of the city the huge Obelisk Ridge entirely hides the entrance to the Siq. In the light of the setting sun this great broken wall becomes for a short time every afternoon of a blood-red colour so unbelievably brilliant that one would not dare to put it in a picture. The northern part of the east wall, the mass known as El Khobza, carries the long line of classical monuments and of places of cult, mentioned already. The upper surface of El Khobza forms the rounded, bloated-looking white sandstone mass seen from Elji, and has been found to carry several Sacella.

The open ground to the north of the Wadi Musa slopes upwards like that to the southward, very rough and broken, to a watershed 4 or 5 miles distant. Across this, as well as across the southern watershed, traces are still here and there visible of the Roman south–north route.

Petra has much interest from the orographical and geological point of view, but no doubt its chief interest has always been rather on the human side, the curiosity and sometimes wonder and even admiration connected with the rock-carved monuments and other records which

its inhabitants have left behind them. These remains, although they have often been called simply *tombs*, are in reality of very varied nature. They include many "holy places," sacella and others, with sacrificial arrangements, altars, basins, shrines, symbolic ("idol") blocks, votive inscriptions, triclinia for religious, funereal, or other feasts; some imposing temples, many living chambers and others probably for trade purposes, as well as places of sepulture. For one single word which may cover all these, I have ventured to adopt the expression "monument," which, on Dr. Johnson's authority, means "anything by which the memory of persons or things is preserved."

We do not know who were really the constructors or the users of the earliest monuments which we find at Petra, but apart from those dating in Roman times after the first century of our era, the greater part of them were probably the work of Nabateans, a Semitic (Aramæan) race of Arabs of considerable importance during at least 600 years, from 500 or 600 B.C. onwards to the time when their kingdom became Roman. It is very possible that it may be found that some of the earlier "high places" were the work of the Edomites, or other predecessors here of the Nabateans.

In 647, a few years after Esarhaddon's expedition against Egypt, Nabateans are mentioned with the Arabs of the Hauran as among people dealt with faithfully by Assurbanipal, who attacked the kingdom of Judah at that time. The region of Petra may have fallen in the route of Pharaoh Necho to the Euphrates, or of his retreat after his defeat by Nebuchadnezzar at Carchemish in 604; but the western route seems more probable, although Strabo* describes it as more difficult, and speaks of the route to Egypt through "the Arabia of the Nabateans" as being the more desirable in his time.

The region between Assyria, Babylonia, or Persia and Egypt was traversed repeatedly by great armies† during the next 150 years; but their exact routes are not certainly known. Very possibly the Nabateans at Petra were left unmolested by Easterns or Egyptians after 647. In any case they do not seem to be again mentioned in history until the time (312) when Petra was attacked unsuccessfully by a general of Antigonus I.

In 85 B.C. Aretas III., the king of the Nabateans, was a tributary of Rome, but was the ruler of a country which extended from Damascus to Medain Salih, some 600 miles. In 106 A.D. Trajan destroyed the Nabatean nationality, and the country became entirely Roman.

Neither the date nor the manner or cause of the ultimate destruction of the city is known. It appears to vanish from history in the sixth or seventh century, to be heard of (at least as to its site) in Crusading times, and then to remain more or less legendary until Burckhardt's visit.

* Strabo, cap. 803.

† See Hall, 'Ancient History of the Near East,' ch. x., xii.

For many centuries it can only have been visited by Badawin Nomads camping in its caves. When or by whom the tombs were rifled, as they have been very thoroughly, remains also entirely unknown.

Strabo, writing about 24 B.C., speaks warmly of Petra (on the information of Athenodorus *), as being a place governed by good laws, with plenty of water and vegetation of all kinds, with white-haired sheep, large oxen, and camels, and with much commerce. The people, among whom he says that many Romans lived, inhabited costly stone-built houses. They were temperate and religious, honouring their god, whom he thought was the Sun, making daily libations and burning incense at household altars. Oddly enough, he says also that they thought dead bodies no better than dunghills, and even buried their kings beside their privies. This seems unbelievable in view of the hundreds of elaborate tombs which must have been in existence before Strabo's time.

I am afraid that these few paragraphs form a fair summary of all that can be said with certainty about the people who seem to have built or carved the "rose-red city," although many pages have been printed in saying it.

The bulk of the Petræan monuments divide themselves into two great classes: those which were, and those which were not, connected with some kind of religious observances, including among these feasting. But apart from monuments which can be definitely placed in one or other of these categories, there are a very considerable number, among them the very oldest, which it is not yet possible to assign definitely to either. There are in the first instance a large number—probably a couple of hundred, at any rate—of rough caves or chambers of uncertain purpose which have never been catalogued either by Brünnow or Dalman, but which may not unreasonably be supposed to be earlier in date than the time when the inhabitants of Petra—Nabateans or their predecessors—became architects, whether this time be the fourth or fifth century B.C. or still earlier. Some of them may always have been intended for use as tombs; many of them may, however, probably enough have been intended as dwelling-places of special safety and security, some of them for use in trade purposes. At present we have no data on which to found even speculation, except the knowledge that within that region cave-dwelling was very common in early times.†

* Strabo, cap. 779–780. Athenodorus was a stoic philosopher, a teacher and intimate friend of Augustus. He was born in Petra, perhaps about 80 B.C.

† One of our visitors last year, Mr. Oscar Raphael, found two well-made palæolithic implements on the surface of the ground in the Wadi Musa, implements very similar to those which Mr. Doughty found fifty years ago near Ma'an. One cannot make any guess as to how far back the Stone Age may take us in Transjordania, but certainly the architectural work can only have been accomplished long after the inhabitants had arrived at a pretty free use of iron.

There is another type of monument of which some examples certainly must come very early in Petræan history, and of which also the full purpose still remains uncertain. These monuments are practically limited to three small districts in Petra; they take the shape of immense four-sided block towers from 30 to 40 feet high, detached on all four, or on three, sides. Some twenty-six of these in all have been counted by Brünnow, of which about half contain no interior chamber whatever. The majority of them have projecting crow-step ramparts of Assyrian type.* It may have been that in cases where no sepulchral use was intended for these monuments they were looked at simply as a glorified version of the block symbol used by their constructors to represent the god they worshipped. One of these solid block towers is capped with a gigantic serpent in coils around a centre—one of the very few cases in which animal representation occurs at all in Petra.

Another monument as to the purpose of which I am at a loss, and which has not been previously noticed, is a wall some 35 feet high facing a large cleared level space, on which are carved six shallow vertical niches (apparently unfinished), each about 8 feet high by 4 feet broad. Above them are four large holes, each a foot square and of some depth. The hollowed rectangles are reminiscent of the rock wall at el-Khreyby (El Khureibeh) discovered by Doughty, where beside a number of niche tombs were shallow niches containing images of monsters in high relief.† The Petra niches, however, are twice the size of those at el-Khreyby. The whole wall is so badly weathered that the monument has every appearance of great age.

No doubt among the earliest of the "monuments" are simple rock graves, which frequently occur in groups near some "holy place," and may be supposed to be more or less contemporaneous with it. In the open part of the Wadi Farasa, however, where no place of cult has been discovered, I found a number of these graves. Sometimes these are mere graves cut down into the rock with their edges rebated to carry cover stones. Often, however, they are shafts sunk from some upper level into open caves or chambers 10 or 20 feet below, the fronts of which originally, no doubt, were closed up, although not furnished with any architectural ornaments. Under these circumstances the burial would consist in lowering the body down from above into a place where it would remain fairly safe from molestation either by man or beast.

In numerous cases there is in the back wall of an open chamber (sometimes an artificially enlarged cave) a recess more or less obviously in the nature of a shrine which could hold an image or an altar, often

* See, for example, the bronze model of an Assyrian tower in the British Museum (No. 91,250), dating between 900 and 700 B.C.

† 'Arabia Deserta,' vol. 1, ch. vi. p. 159. A large tank-like construction above the opening of the Wadi Farasa, having twelve shallow niches, bears a sort of resemblance to this monument.

accompanied by a number of large loculi in the walls. In these cases it does not seem probable that the chamber was used as a tomb; a temporary or permanent dwelling-place appears a much more likely purpose. This type of chamber appears to be altogether absent among the *real* tombs of Medain Salih, which strengthens the impression that it is not sepulchral. Near the theatre a very large chamber, the roof of which has now fallen in, was entered by a doorway which has provision for a lintel, and therefore must have had a door. It contains thirteen or fourteen high recesses, each more than 6 feet by 3 feet, and 8 feet deep, separated by thick walls, the whole being now most beautifully marked by weathering in coloured strips of red, orange, blue, and yellow (Pl. 10). It has no indication that it was to be used for burials, and the loculi are certainly not suitable for this purpose. It appears both from its construction and position to have been rather a Serai or a store-house, or both, for merchants or traders passing through Petra. Another interior, on the opposite side of the valley, also entirely without any façade, contains a number of huge loculi on three of its sides, some at the floor-level, some quite high up. This also may probably have been a storehouse. Like the last mentioned, it is situated close to the exit from the Siq into Petra.

Another monument, one which has been specially noted by Brünnow (Brünnow, No. 781), contains seventeen large vertical niches with a large central niche, this last having an architrave over an opening into an inner chamber containing a trough grave. Such an arrangement suggests that the great niches were *not* for burials, but probably rather for living-places, temporary or permanent. This particular monument, like most or all of those which contain any obvious grave, has a normal Petræan façade.

On El Habis, close by a chamber which looks like a house front (having a plain door opening, with two plain window openings on each side of it), is a small chamber weathered entirely open, on the back wall of which are engraved symbols which may have some esoteric meanings, although I have failed to find any one who can interpret them. Possibly they are the "Wasms" of some Nabatean tribe. They appear to cover a recess in the back wall of the chamber, but only the upper part of the recess is visible over a deep filling of rubbish.

A certain number of monuments which are probably tombs, and which are to all appearance very old, as well from their weathered condition as from their simplicity, show in such quasi-decorative features as they possess a great analogy with Egyptian work. Their only decorative feature is either a straight groove or a straight bar * over the top of the doorway, or sometimes a combination of these (Pl. 11). Comparison with Egyptian decoration seems to indicate pretty clearly whence the

* This groove is quite separate from the notches or hollows provided for the insertion of a timber lintel.

Gorge of Ed Deir

6. LOOKING NORTHWARD FROM ABOVE THE ROMAN TEMPLE

Obelisk ridge J. en Nmer Southern watershed

7. LOOKING SOUTH-EAST ACROSS THE CITY OVER A "HIGH PLACE"

N. end of El Biyara

Opening of Es Siyagh

8. BETWEEN THE FIRST AND THIRD NORTH-WESTERN WADIS

South

El Biyara

Jebel Harun

The Acropolis

9. PANORAMA FROM PLATEAU OF ED DEIR (ABOUT 3,850 FEET), ACROSS RAVINE OF ES SIYAGH

10. INTERIOR OF ROCK DWELLING WITH FOURTEEN SMALL CHAMBERS

11. TOMB WITH RECTILINEAR DECORATION AND IDOL-NICHE ON LEFT OF DOOR

idea of this formal rectilinear ornament came.* A very notable block tomb in the Bab es Siq (No. 9 in Brünnow's list), which is very badly weathered, seems essentially to be a large illustration of the same thing †

There is one difference between tombs and other monuments which appears to be quite general, namely, that every monument the interior of which shows anything definitely like a grave has some kind of architectural façade. There are a large number of monuments having façades which are certainly not graves, but the converse does not seem to occur. This strengthens the probability that the numerous cases of multi-recessed chambers without any front were not burial-places. They are certainly more suitable in many cases for dwelling or sleeping places or for store-houses. The latter would be a necessity of a great caravan crossing-place like Petra, and it seems probable that several of them really give us examples of early Arabian serais. The employment of an architectural façade seems to have been reserved as an honour due to the god or to the dead rather than to the living.

Dealing next with the "holy places," we have no means of saying whether or not the earliest of these come before the earliest of the tombs, still less whether they were earlier than caves or chambers used solely as dwellings. But one is compelled to recognize that centuries may have elapsed between the very rough "holy places" above the Wadi el Hisheh

* See, for example, the Sarcophagus of Khufu-Ankh in the British Museum, or any of the "false doorway" reliefs. Unless I am mistaken in interpreting a much worn relief, a similar feature appears in a fortress of Assur-Nasir-Pal, about 880 B.C.

† A small chamber of this type (Brünnow, No. 450) has some special interest. Probably a very ancient tomb from which, as from many others, the bodies of the original occupants had long been removed, it is the only tomb which has so far been recorded as still containing skeletons. It was examined last spring, and five complete skeletons were found there and carefully taken away by Dr. Dalbey to Cairo, where they were examined by himself and Dr. Derry. Dr. Dalbey writes me as to this, that the skeletons were found in a rock-cut grave dug in the floor, covered with a flagstone, and sealed with cement. He saw no sign of an inscription. The bones represented five complete skeletons, two adult males, two adult women, and a child of twelve. They were roughly superimposed. After describing the three lowest skeletons he says that the two men's skeletons were very remarkable. They have big massive bones such as would have supported immense frames. By the length of the femur he judges them to be the bones of men about 6 feet or 6 feet 2 inches in height and weighing at least fifteen stones. There are no bones known in Egypt—Dr. Derry agrees with this opinion—the grave of all the fighting races of history, that compare with them. The dynastic Egyptian princes and nobles had bones longer, but not nearly so massive; the ruling races in dynastic Egypt were fine, big, tall men, totally different in skeleton formation from the Egyptian manual workers of those days, whose skeleton is the same as that of the Fellahin of to-day. Bones that are in the Cairo Museum belonging to authentic graves of Alexander of Macedon's soldiers and the Persian invaders are far smaller than these Petra bones; the Dunkas and Shilluks of the southern Sudan have bones far longer, but again not nearly so massive. For these reasons Dr. Dalbey suggests that these two men (one had suffered for many years from a septic wound of the breastbone, probably the result of a spear-thrust), were Vikings—possibly ex-gladiators—for he knows of no other race whose bones were so massive or whose frames were so large.

11. TOMB WITH RECTILINEAR DECORATION AND IDOL-NICHE ON SMALL BIRKEH ABOVE

12. INTERIOR OF ROCK DWELLING WITH FOURTEEN

described and illustrated by Dalman, and the carefully finished altars and steps and seats of the great Sacellum on the Obelisk Ridge. In the one case as little as possible seems to have been done to change the shape of the natural rock. In the other no natural shapes are left; the "holy place" has become as fully artificial as a built temple.

Very simple places obviously connected with worship, and presumably among the earliest of such places, are the chambers mentioned above—either entirely artificial or caves artificially enlarged—in one wall of which is a niche or shrine for an image of Dusares. This image, the symbol to these folk of the All-powerful (I really dislike calling it an "idol") seems always to have taken the form of a rectangular block—generally at Petra 2 or 3 feet high and about 8 to 12 inches square—frequently standing on an angled base. Very many shrines remain, but in most cases the symbolic blocks have disappeared. Dr. Dalman, however, who has made this aspect of Petra his special study, states that he found no less than 180 of them in Petra.

In the Siq and the Siyagh, and on the southern and northern approach routes to Petra, as well as in places obviously devoted to religion, there are numerous graffiti scratched on the rocks representing outlines of the sacred block or of an altar, or of an obelisk; in some cases a miniature block is carved in relief in a little niche or shrine. In other cases several little blocks stand in a hollow recess side by side. Their exact meaning, especially where (as in one case) there are ten in a row, is not easy to guess. From the inscriptions which very frequently accompany these it seems clear that they were carved simply as a reminder to the deity that his worshipper remembered him, for much the same purpose as the bits of rag tied to sacred trees in so many places in the East.

One could not have a better illustration of a literal "high place" than a monument on an isolated promontory of rock (Pl. 7) between the second and third north-west wadis, on one side of which a façade has been cut, and in which is a large chamber. The back of the rock has steps cut up to its top, and on the top of it what appears to be an altar. Two large basins, one probably a tank, are carved out of the rock plateau from which it rises.

The most impressive of the "holy places" at Petra are certainly the open sacrificing places, which I believe may properly be called Sacella.

What may on various grounds be thought to be one of the older Sacella lies on the edge of the gorge behind El Habis. The Dusares block, if it ever existed, has disappeared, but just above the Sacellum, on a shelf between it and the west wall of El Habis, is a remarkable range of chambers round an excavated and levelled courtyard which has not been dealt with in any account of the Petra monuments, and which must have been a garden. In one corner of the courtyard is excavated an old tomb containing a coffin-shaped trough in a niche in its back wall. On

two sides of the yard are rectangular chambers with plain door openings, none of them having any façade, or showing any indication of sepulchral purposes. It suggests itself that the court was really for the residence of the priests who looked after the adjoining Sacellum and another older Sacellum high above it on the ridge of El Habis.

It is noticeable that there is no definite orientation in any of these Sacella. Their arrangements appear to have always been determined by the configuration of the rocks from which they were carved.

The finest of the Sacella, but certainly not the oldest of them, is on the north end of the Obelisk Ridge, some 600 or 700 feet above the valley level. To reach this up the narrow Wadi Mehafir must always have been a laborious business—the ravine is extremely steep—but helping steps have been cut in various places. A direct route to the Sacellum from the northern end of the Obelisk Ridge is somewhat less laborious; but the route by the Wadi Mehafir leads directly to the plateau on which the obelisks stand, which may probably be a much older "high place" than the Sacellum itself.

At the top of the wadi and crossing the Obelisk Ridge at right angles is a shelf or terrace, on the north side of which are immense worked-stone surfaces forming probably part of the protection of a fort above and to the north of them of which very little now remains.

On the south side of the shelf is an irregular plateau at a somewhat higher level, on which stand the two obelisks already mentioned (Pl. 12). One can be certain that these two erections, irregular as they are, were not fashioned out of upstanding rocks without some definite purpose and meaning, which we must suppose to have been connected with a religious cult. There are near them a great number of graffiti and votive inscriptions, which may well indicate the existence here of a "high place" long before the great Sacellum on the north end of the ridge was constructed. But such investigations of the site as have been made hitherto seem only to have led to somewhat wide differences of opinion on the part of the archæologists who have written about the matter.

On the other side—that is the north side—of the shelf, past the ruined tower of the fort, and at the highest level and narrowest part of the ridge, lies the often-described "holy place" of Zebb 'Atuf, the largest and most complete and least weathered of all the Sacella of Petra. The sacrificial basin, itself perhaps an altar also, stands beside a central altar, on one side of a great cleared and levelled rectangle, like a gigantic triclinium, about 50 by 22 feet. It is clear that if there were animal sacrifices or burnt offerings of any kind here, the animals must have been small enough to be somehow carried up, whether dead or alive, for walking up would be impossible. A good deal has been written about the probable functions of the altar, basin, tank, and seats, but I fear that what has been written amounts to little beyond guesswork. It is very singular that in this notable place of worship, although there is plenty

of room for celebrants, there is absolutely no room, on account of the narrowness of the ridge and its steep sides, for other worshippers.

There can be no doubt, from the number of enclosed triclinia having a shrine in the centre of the back wall, that religious feasts were a usual function of Petra. (Strabo tells us that thirteen was the proper number to sit down at once.) In one case only we found a grave arranged in a triclinium, but funereal or memorial feasts may have been as common in Petra as in many other parts of the world.

Apart from the monuments which are directly or indirectly connected with religious observances, and the others of doubtful purpose, but very probably of great age, which I have mentioned, the great bulk of the Petræan monuments which have been examined—some 524 in all in Brünnow's list—can be clearly divided into three main classes. The division is in a general way chronological, although undoubtedly monuments of the types which were the earliest must also have been sometimes constructed long after later and more developed types had come into use. It is, however, noteworthy and certainly remarkable that the three types are—except in single doubtful instances—never *mixed* in Petra.

If we indicate each type, purely as a matter of convenience, by the probable source from which one of the most obvious characteristics of its architecture has been derived, and not with any more general meaning, they may be conveniently indicated as Assyrian, Egyptian, and Classical. The oldest of the monuments having any architectural pretensions whatever I have called the Assyrian type, and this class covers one-half of the whole number. Its characteristic is that along the upper part of the plain flat face there run either one or two lines of what look like crow-step gables above a plain straight moulding. Examination of Assyrian carvings in the British Museum dating perhaps as far back as the ninth century B.C. indicates at once the source of this type of decoration.*

It is particularly noticeable that the lines of crow-steps in Petra, as also in Assyria, are never paired *as gables*, but are always paired as *half gables*, the outermost one at each end being a half gable only. I think the suggestion may be made that the pair of half crow-steps correspond to the horns of an altar, a suggestion which becomes much more striking in connection with what I have called the Egyptian class of monuments. In the older Assyrian carvings the crow-steps are often smoothed out into triangles, which render them still more like the altar horns; this, however, seems never to have been copied either in Petra or in Medain Salih.†

* See, as two out of many examples, the lion hunt of Ashurbanipal (B.C. 648) and the bronze plaque of a building front (No. 91,177), probably 900 to 700 B.C.

† The Assyrian reliefs in the British Museum show (with one exception) little gables of *three* steps. In Petra the number of steps is invariably four in the "Assyrian" type and five in the huge "Egyptian" crow-steps.

The simplest monuments of what I have called the Assyrian type (which are conveniently called by Brünnow "pylons," although few of them are really of pylonic shape), of which there have been counted 170 in Petra, have one line of crow-steps only (Pl. 13). Very many of these have no decoration at all over the doorway. The larger number, however, have a straight horizontal groove cut above the doorway; some have a straight ridge instead of the groove; and a very few also a flat triangular groove. Only three out of the whole number, probably carved much later than the rest, head the doorway with anything like an architrave.

The rest of the monuments of the Assyrian class have each *two* lines of crow-steps, one above the other. Of these the great majority have plain doorways like the single-row monuments, but ten have a straight architrave, and three a quasi-classical pediment over the doorway.

The straight groove or ridge above the door is, as I have noted, very reminiscent of earlier doorways in Egyptian tombs, and may well be derived from them, although possibly the straight line here may have an esoteric meaning not now intelligible to us.

The second type of Petræan monuments I have called "Egyptian," because one of their outstanding features is the use of the hollow quadrantal type of cornice (the "cavetto") familiar in Egyptian structures. This heavy cornice (sometimes doubled) is associated invariably (there is only one single freak exception) with a change from the line of small crow-steps to two huge half-steps occupying the whole breadth of the monument (Pl. 2). With these the face of the gigantic block unquestionably looks very much like an immense altar. There are in all about 190 monuments of this type, all of them having the cavetto, all of them having also the two great half-gables, neither one of these features ever occurring without the other.*

It is difficult, and for myself not possible, to suggest any such relation between the cavetto and the stepped semi-gables as might explain how the two things came to be rigidly combined for centuries in these monuments. But if the root idea of the semi-gables had been that they resembled the horns of an altar, the heavy cornices might possibly be taken as replacing the appearance of the angled cap of the altar below the horns, which is shown very frequently in the graffiti.

Of the monuments of the Egyptian type, about one-fifth only have plain fronts and perfectly simple doorways. About one-third of the whole have a pilaster supporting the cornice at each side of the front, and frequently also a more or less classical decoration on or over the doorways (Pl. 2). Nearly one-half of the whole, finally, have an attic with a

* Miss Martineau ('Eastern Life, Past and Present,' vol. 3, 1848) says that she saw a tomb, or tombs, with large crow-steps reversed so as to form an imitation gable. No one else, however, seems ever to have observed this. It may well have been a mistake in recollection.

frieze, sometimes plain, sometimes elaborately filled up between two cornices, and of these a large number have doorways of classical design. It is natural to think that the semi-classical doorways with their capitals, the attics and friezes, must have been derived from classical models, which is most probably the case. In any case they must represent a gradual development of a simple design into something much more complex and decorative. But at the same time it must be remembered that there were pilasters in Egypt as long ago as 3000 B.C., and that early Assyrian reliefs show pilasters having elaborate capitals, as well as rosettes and half-round arches.* So that classical sources are not the only ones from which these additions may have come.

In the matter of capitals the Nabateans seem to have been really original, and having apparently invented a particular type, they adhered to that type rigidly, long after the Romans had taken over the country, and after tombs and temples purely classical had taken the place of the original forms. Some of the earlier visitors to Petra saw in the Nabatean capital an attempt at the Corinthian, and so described it. It certainly has some general constructive resemblance to an Ionic type, but only the general resemblance which both of them have to a horned altar. I think we may fairly give the Nabateans credit for the design of their capitals, even if our taste does not think that it was beautiful. Certainly they adhered to it with astonishing tenacity to the very end, even in the monuments which in all other respects were entirely classical in their origin and treatment. There do not appear to be more than two, of all the monuments in Petra, which have capitals of any other than the Nabatean design, out of nearly 130 which possess pilasters or columns of some kind.

In a few monuments there are traces of the use of stucco, sometimes inside and sometimes externally. The general statement which has several times been made by the older visitors that all columns and pilasters were once stuccoed and painted, would indicate, if it turned out to be correct, an interesting reminiscence of Egyptian Art.

Of the Egyptian type of tomb *one* only has the feature, unique in Petra, of carrying a very long inscription (in Nabatean) making the purpose and ownership of the monument quite clear. It is one of the only three tombs at Petra which carry any inscription at all. Unfortunately, the lower part of the inscription, presumably containing a date, has broken away. The inscription itself is prohibitory of any unjustified use of the tomb, but hardly shares the more comminatory character of some of the inscriptions at Medain Salih.

Out of the 524 monuments, therefore, nearly 90 per cent. belong to the Nabatean class, in the two types which I have called Assyrian and

* Jaussen points out ('Mission Archéologique en Arabie,' vol. 2) that the cavetto also occurs in Assyrian or Babylonian buildings. See also panel No. 92 in the Assyrian Basement in the British Museum.

Egyptian respectively. Of the remainder there are a certain number of which the façade is an arch with or without some decoration in the tympanum. These are generally said to be Syrian in design; I am unable to place them at all as to date. The arched tombs have always pilasters carrying the arch, and in many cases also smaller pilasters flanking the doorway, while the pilasters are often capped with a simple angular moulding and not with any proper form of capital. The angled cap occurs nowhere else in Petra, although it occurs quite frequently in the first-century tombs of both Assyrian and Egyptian type at Medain Salih.

There remain, finally, only some thirty-six monuments beyond those which I have attempted to classify. Of these twelve are incomplete, although certainly of classical design so far as they are carried out.* The third or Classical division of Petræan monuments contains, therefore, only twenty-four out of the whole number, all belonging doubtless to a time after the Roman Conquest in 106 A.D. Perusal of the records of tourists and visitors to Petra generally shows how singularly one and all have been obsessed by the beauty and strangeness of these quasi-classical monuments, which of course are the largest and most pretentious in Petra and those whose appearance is most striking. Having seen the glory of the Khazna illuminating its dark ravine, and of the Deir on its noble summit, and the Palace tomb with its great palatial front, they have had no eyes for the rest, and apparently themselves thought, and certainly gave others the impression,† that these great erections (if that word may be used) were the monuments really characteristic of the rose-red city, instead of being the work and design only of the people who took possession certainly five or six centuries after the great scheme of wall carving had commenced, and after all but a very few of the monuments which we now see had already been long in existence. I do not offer any apology for being the Colenso to the Pentateuch of the Tourists. The classical monuments seen in the glory of the desert sunlight and in all the colours of the desert sandstone are absolutely fascinating, But from the point of view of knowing the people who once lived at Petra and who carved these wonderful "frontispieces" (as Doughty calls them) in honour of their dead and of their god, and who worshipped under the complicated system of religious observances of which we can so far only guess at the nature, the classical monuments are the least interesting. The most important monuments are certainly those which will carry us back furthest in our knowledge of a very ancient civilization of which at present we are largely ignorant. It is naturally to those, therefore, that I have chiefly called attention.

The classical monuments are nearly all to be found in the eastern

* I give this on the authority of Brünnow's statistics. He speaks of these as being all much destroyed by weathering, only a pediment being definitely defined.

† Miss Martineau and her friends form a striking exception to this.

wall of Petra. One group of them stands on the north-east wall just at the exit of the Siq, and others on the western side of the obelisk ridge and in the Farasa valleys just south of it. Of the classical monuments in the north-east wall, the "Urn Temple" is one in connection with which great trouble has been taken at some time by way of building up a courtyard in front of it over arches, as well as carving out a sort of cloister with columns on each side of the yard. We do not know its date, but the construction of the built arches as well as its design suggests to us that it must have come after the end of the first century A.D. It was used as a Christian church in later times, and a painted inscription enables a date of 448 A.D. or thereabouts to be fixed for this use, for which the interior has probably been altered. One can, however, hardly think of it at any time as other than a temple of some sort.

The great façade which the French call the "Trois Étages," and the Germans the "Stockwerk Grab," differs from all the others in being in effect a copy, or intended to be a copy, of a Roman palace. For a name it may be simplest to call it "The Palace." It contains four plain chambers separated internally by walls and having four doors to the outside. It is presumed that it was intended as a burial-place for several branches of some influential family, but the interior chambers are plain four-sided vaults of which only one contains niches apparently sepulchral.

The same thing is also true of the so-called Corinthian tomb, which is close to the Palace. This tomb and the Khazna are the only two of the whole range of Petræan tombs, so far as I know, having columns or pilasters with classical capitals.

The Lion Monument (which is one of the few classical monuments, like the Deir, on the western side of Petra) is a triclinium and not a tomb. The lions are in low relief on each side of the doorway (Pl. 15). The faces of the Nabatean capitals between the horns have a little scrollwork decoration. The frieze carries two Medusa heads and four pateræ, and in general it is obvious that the monument must be a late one. But it is very noticeable that the feasts held in it must have been connected with the worship of Dusares, whose block symbol stands in a flat niche to the left of the doorway.

The largest, and architecturally perhaps the finest, of the classical monuments is the temple known as Ed Deir (Pl. 3), on the north-west plateau already mentioned. It is of huge dimensions, about 140 feet high and 150 feet broad.* The great solid urn on its top, with its pedestal, measures 34 feet in height. Much criticism has been levelled at this work, as at the other classical monuments, by way of showing how far their design falls short of Greek standards of beauty. I confess that such criticism seems to me almost as futile as to compare the delicious Tibetan folk-songs which we have recently heard in this room with

* The width of the west front of Westminster Abbey is about 100 feet, and the height of its nave 102 feet.

12. OBELISK RIDGE: WESTERN EDGE OF DESERT BEYOND

13. "ASSYRIAN" MONUMENTS UNDER EAST WALL OF OBELISK RIDGE, ROMAN THEATRE ON RIGHT

14. THE OUTLET OF THE SIQ

15. A TRICLINIUM OF THE "CLASSICAL" TYPE, WITH LIONS IN LOW RELIEF ON EACH SIDE OF DOOR. A SYMBOL-BLOCK OF DUSARES IN SHALLOW NICHE ON LEFT

Brahms' "Ewige Liebe." If we are not catholic enough to appreciate both, the fault is with us and not with the folk-songs. It has been suggested that the Deir dates from about 250 A.D. There seems to have been still an Annual Festival in honour of Dusares at Petra later than the third century A.D. On a mound in the centre of the Deir plateau there once stood a Roman temple of classical form, a built and not a carved-out erection, but the building has fallen down altogether, and (excepting one elaborate shrine) only the shape of the stones tell us what it was.* In the ravine which leads up to it from the Wadi Musa are inscriptions which show that it was still in use as a sacred place or place of pilgrimage fairly into Christian times. There is therefore a probability that this "high place" may have been a place of worship or sacrifice of some kind for at least the greater part of a thousand years.

The Deir plateau offers in all directions magnificent views of Petra and its surroundings, from the distant hills of Idumea on the west to the desert on the east, and north and south over the whole extent of the Wadi Musa between its watersheds (see Pl. 9 and 4).

The most celebrated monument at Petra is no doubt the temple, or temple tomb, in the Siq, which is known as the Khazna. It may possibly date from the time of Hadrian, about 130 A.D., but if so it must be one of the first of the great classical monuments dating after the Roman occupation. It contains, however, no inscription to give a clue to its date. Its situation in a little ravine crossing the Siq at right angles allows sunlight to reach it for certain hours every morning, and the effect of this on the rosy sandstone, as it suddenly appears at an opening in the ravine, is so wonderful—and indeed beautiful—that the enthusiasm of those who have seen it as they came out of the darkness of the great gorge is not at all to be wondered at.

The number of dated inscriptions at Petra is so very small as to give us practically no light on the question of the dates of the monuments. The very numerous inscriptions on the Medain Salih tombs (where there is an inscription tablet on nearly every tomb), give us, however, certain limiting dates with fair certainty. The dated tombs there cover every class of Petræan monument except the Classical, and they are dated from 1 B.C. to about 80 A.D., that is to say, they cover the first century of our era. Their differences and their similarities compared with Petra are very remarkable.† Practically all of them were actually tombs, and

* Musil, *op. cit.*, p. 143. At el-Khreyby, south of Medain Salih, Jaussen found the similarly ruined remains of a large Roman sanctuary.

† Both Jaussen and Savignac and Puchstein have called attention to various more or less minute architectural differences between the "frontispieces" at Medain Salih and those at Petra. They have not, however, dealt with what appear to be more fundamentally interesting differences.

It is specially noteworthy that the characteristics of the two types which I have called Assyrian and Egyptian respectively, which are never mixed at Petra, have been in several cases combined in one tomb at Medain Salih. The use of a carved eagle,

14. THE OUTLET OF THE SIQ IN LOW RELIEF ON EACH SIDE OF DOOR. A SYMBOL-BLOCK OF DUSARES IN SHALLOW NICHE ON LEFT

each belonged to a certain family whose name is given in the tabular inscriptions collected by Mr. Doughty and afterwards by Euting and Jaussen and Savignac. These inscriptions duly curse or fine any unauthorized person who may presume to use the tomb, although doubtless the bones and cerements, and particularly the bad smell, which Mr. Doughty found in them, belonged to interments so many centuries after the curse was engraved that it was no longer effective, even if the Arabs could have deciphered it.* From the less finished design of the Medain Salih tombs generally we may infer that they were carved by inferior masons who were working from general recollection of what they had seen in the older city.

Not a single representative of the Classical type is to be found at Medain Salih, from which it may be a fair inference that that type did not exist at Petra until at earliest the end of the first century; in fact, no doubt until the Roman Conquest in 106 A.D. This gives us a reasonable earliest date for the Petræan monuments of Classical type.

The earliest of the Medain Salih tombs, which is dated B.C. 1, happens to be one which copies almost the most elaborately decorative of the Egyptian type at Petra. The date at Medain Salih, therefore, shows that the most elaborate of the principal "Egyptian" façades had already been fully worked out, and indeed considerably used, in Petra before the commencement of our era. Of this type there are only twenty-four complete examples altogether at Petra, and of course even this small number must include all those constructed in the first century A.D., for no further development beyond this design occurred until the Classical type was brought in a century later by the Romans. The construction and gradual development in style of more than nine-tenths of the Petra monuments which have been classified must therefore be covered between the dates at which the Petræan constructors first began to copy the Assyrian decoration and the beginning of our own era. Much more

generally over the portal, which occurs only once at Petra, is frequent in the sixty-five tombs at Medain Salih. The latter also carry almost invariably a prepared tablet for an inscription, a thing which never occurs at Petra.

Of the 260 Assyrian type monuments at Petra *none* have pilasters at doorway or sides, while 8 out of 18 of this type at Medain Salih have this feature. At Petra just one in three of the 190 Egyptian type have pilasters, while every one of the 47 of this type at Medain Salih have them. Some 22 out of the 65 Medain Salih tombs also are of the most developed Egyptian type with double cornices and a frieze between them, while this appears at Petra only in 12 monuments altogether out of 520. On the other hand, only one of the Medain Salih façades has a plain straight groove over the doorway against more than 200 at Petra. The majority of the capitals at Medain Salih are of what may be rightly called the Nabatean type, although generally somewhat clumsily proportioned, as if from imperfect recollection or knowledge. But a very considerable minority have only angled blocks for capitals, a peculiarity which at Petra is confined to certain of the few arch-topped monuments there.

* Doughty, *op. cit.*, vol. 1, p. 180, etc. Also Jaussen, *op. cit.*, and Euting. It is noticeable that in these inscriptions several gods are mentioned, while in Petra even the feminine Allat occurs very seldom in addition to Dusares.

information than is at present available must be forthcoming before we can fix the early limit.*

One other limit of date can, however, be reasonably suggested. Almost exactly a half of the whole number of monuments show no traces of Greek influence. No doubt the construction of simple undecorated tombs would continue to some extent after the evolution of the more decorative types, but with due allowance for this there must have been probably some 200 monuments (besides perhaps as many more not yet catalogued) in existence before about 250 or 300 B.C., which would appear to be the earliest date at which it is at all probable that relations between Greeks and Nabateans can have been sufficiently cordial to overcome the hostility caused by Antoninus' attacks in 312 B.C. upon a very conservative people.

But even further: before the earliest date of the architectural monuments, there have probably been generations of cave dwellers, and quite possibly of cave buryers, who worshipped and sacrificed to their god (or in some cases to their gods), even further back than the time when the Israelites tried to exterminate them.

No one, I think, who has lived among the Petræan monuments even for a short time, would be willing to credit the cave-dweller, who simply squared out a cave or cut a doorway into it, with the capability of carving out a huge block surmounted with a double line of crow steps, nor would he credit the artist of that block with the possibility of designing the latest tomb of Egyptian type with its plentiful reminiscences of classical art, nor again would he credit even that artist with the knowledge or wish to design and carve the classical façade of Ed Deir. Such a development must have covered centuries; how many we may know when the site of Petra is excavated—if excavation is ever permitted; but we shall hardly know before.

Before the paper the President (the EARL OF RONALDSHAY) said: Our lecturer this evening, Sir Alexander Kennedy, is probably best known to you as an eminent engineer who has been associated with great electrical enterprises in various parts of the world, and one, moreover, who in the past has done much in the interests of engineering education. But to-night he comes before us in the *rôle* of a traveller and an admirable photographer; a traveller, moreover, who has spent some little time at that most interesting but little-visited city, Petra, a city the first origins of which are buried in obscurity, and one which, after flourishing as a great Roman centre in Roman times, disappeared from the pages of history and lay buried and unknown to the world for a period of some sixteen centuries, until it was rescued from oblivion by an explorer some hundred years ago. Sir Alexander Kennedy will be able to show us a series of photographs of the remarkable monuments of this

* Euting found a long Nabatean inscription on a stela at Teima, of which a cast is in the British Museum, dating from the sixth century B.C., and referring to several gods as well as Dusares, but not, I think, those mentioned in the Medain Salih inscriptions.

ancient city, and he will tell us something—as much, that is to say, as is known—of the history which lies behind it. I now have much pleasure in calling upon him to give us his lecture.

Sir Alexander Kennedy then read the paper printed above, and a discussion followed.

Sir FREDERICK KENYON (Director, British Museum): I take upon myself the part of representing those who came here knowing nothing whatever about the subject. I imagine that most of us, at any rate, knew little of Petra except that Dean Burgon, when a young man, wrote a poem in which he described it as "a rose-red city, half as old as time." I do not know whether you have ever calculated its exact date from that information, but I imagine he took off from Ussher's date for the Creation of the world as the commencement of time; and, if he did, that is not a bad shot. It would mean he put the date of Petra somewhere about 1000 B.C. That is a little far back, because we have no information which takes us quite to such an early date, but is not so very far out. Petra is an extraordinarily picturesque city, and has impressed everybody who has been there. Very little is known about its history. We are extremely grateful—and I am sure I am speaking for everybody here—to Sir Alexander Kennedy for the photographs that he has shown us of this most interesting and beautiful city. They have given us an idea, which few of us can have had before, of what Petra really looks like: a city burrowed out of the sandstone sides of a great valley. The only place I have ever seen in the least resembling Petra is the curious little town of Les Baux, at the south-east corner of France, where the houses have been partially dug out of the rocks and partially built on them. That is what Petra seems to have been: a town inhabited several centuries B.C. in which a large portion of the buildings, at any rate, were dug out of the sides of the hills. I imagine we should be wrong if we supposed that all those caves that we have seen photographs of were graves or places of religious worship. I should imagine that Sir Alexander was perfectly right in suggesting that many were dwelling or lodging places. It was natural to take advantage of a sandstone which could be quarried reasonably easily, so that the houses could be made by digging holes instead of building on top of the stone. That I imagine is what was done by the Nabatæans, and the Romans followed the example which they saw before them and carved those façades which are such striking objects, representing temples, palaces, and buildings of various kinds. But I think what must have struck one in listening to the lecture is how extraordinarily little we know about the Nabatæans and whatever people inhabited Petra before them. Therefore one must look forward to the prospect which Sir Alexander Kennedy held out in the last sentences of his lecture when he spoke of the work of excavation, and I trust that it may prove possible to carry it out.

I have nothing to tell you with regard to Petra itself. There are one or two here who can speak with much greater authority. What I should like to say, as the opportunity has been given me, is something about the work of excavation. It is extraordinarily difficult just now to find men or money for carrying out work of that description. I should like to take this opportunity, and any other I can get, to impress upon an audience such as this, which is interested in such matters, the importance of finding men as well as money for work of this kind. I do not suppose there ever was a time in which there were more possibilities for profitable exploration than now. Many parts of the eastern world have been opened up as the result of the war in a

way they never were before. We have opportunities now for digging in Mesopotamia, Palestine, Egypt, Syria, and in other parts of the world, but those I have named are probably the most important. There are any number of sites which could be dug with profit to history, art, and archæology if only the men and money were forthcoming for the purpose. This country is primarily responsible for several of the countries I have named—Mesopotamia and Palestine certainly; Egypt very largely. Those are countries for which we have the principal responsibility, and we are not doing our duty as a civilized country unless we take the lead in exploration in those parts of the world. We ought not to be content to leave it to other countries to do it, and there is no reason, supposing that the men and money were forthcoming, why we should limit ourselves to those particular countries. There are other parts of the world, such as Syria, which is under French control. There is not the least reason why English explorers should not work there. Just as we welcome French and American explorers and explorers from any other part of the world in the areas that we control, such as Palestine and Mesopotamia, so we have every right to expect that we should be received—and I am sure we should be—by our friends the French in the areas which they control such as Syria or other parts of the world. So that there is any quantity of work to be done, but at the present moment it is almost impossible to find the men.

Sir Alexander told us he had been expecting to have the assistance of Mr. Wace this year in digging at Petra. Nobody could have been better. Unfortunately he is unable to go, and there is practically no one to fall back upon. The few men capable of conducting archæological exploration are already engaged in Palestine, Mesopotamia, and Egypt.

What one wants is some young men who will take the trouble to get the necessary archæological training and take the risk of throwing themselves into an archæological career. It is a risk, because they cannot tell for certain from year to year whether they will get employment. On the other hand, I think I have shown there is a great deal more work to be done than people to do it, and one must trust that if the men were forthcoming the money would also be forthcoming to enable them to work.

In the case of Petra, if we could get somebody to work there, and if those who know the ropes on the spot like Sir Alexander Kennedy and Mr. Philby could facilitate matters, then we might begin to get to know something of the history of Petra. There has been nothing said in the lecture as to any of the small objects of excavation on which history is generally built. There are few inscriptions in Petra; no pottery to speak of, except late Roman pottery, and none of the small objects of worship that one expects to find in an ancient city. For that, presumably, we must wait for spade work, and I trust it will be possible for Sir Alexander's expectations to be fulfilled, and that he will be able before long to find somebody who will be able to go there and get permission to work. We know something of Egypt on the one side and Assyria on the other, and something of the Asia Minor side. But in the northern and southern parts of Syria there is a great deal to be investigated which may give us a key to much early history. At any rate there is the ground, and if the opportunity is given I trust that men will be forthcoming to carry out the necessary work. On behalf of those who came here with no more knowledge on the subject than I, may I offer our sincerest thanks to Sir Alexander Kennedy for an extremely interesting lecture?

Prof. ALOIS MUSIL (Czech University of Prague): The rocks and monuments of Petra have been familiar to me since 1896, and I thank Allah that he

has to-day offered me the opportunity of reviving my memories of them through the fascinating paper and the beautiful slides shown by Sir Alexander Kennedy. In my work 'Arabia Petræa' I dealt with the city of Petra and the people whose monuments we have admired to-night, and in my new works, which are to be published in English only, I shall also speak of these people, because along every great trade route in the interior of Arabia I have found traces of the builders of Petra, who once were the controllers of world trade.

In the same manner as now, every ancient world power was at pains to master the world-trade routes. In the beginning of the first millennium B.C. the centre of the world trade lay in south-western Arabia, whence large caravans carried the goods of South Asia and East Africa north-east to Babylonia and north-west to Phœnicia and Egypt. The Assyrians, the world power of that time, succeeded in obtaining the direct control of the northern part of the north-western road, and the Assyrian troops punished every nomad tribe which harassed the safety of the trade caravans. The Assyrian annals contain many records of expeditions against the tribes, and from these annals we know the original territory of the later lords of Petra. In the seventh century B.C. the tribe of Nabaitai camped east of Petra, in the south-eastern half of the Sirhan depression, hence in the neighbourhood of the Biblical Edomites, who according to the Bible were their relatives, In the territory of the Nabaitai or Nebajoth two trade routes crossed: the one leading from the Persian Gulf through the Sirhan depression to Phœnicia, the other uniting Egypt with Babylonia; therefore the Nabatæans were early accustomed to trade. Hitherto we have not found any record that the Assyrians attacked and vanquished the Nabatæan tribe. After King Assurbanipal had in the years 640–638 broken the force of the Kedar tribe, the Nabatæans took the oasis Adumu, Dumat al Jandal, the Jauf of to-day, and the whole Sirhan depression, and became the most powerful tribe of North Arabia.

Every nomad tribe longs for the tilled country on its borders. When the tribe succeeds in occupying it, such a country serves at first as pasture land for herds and flocks, and as a source of taxes and gifts; later, however, the nomad lords begin to settle, to intermarry with the natives, to accept their manners and customs, and to follow their civilization. The Nabatæans also found occasion to overrun the neighbouring state of the Edomites, whose power had been destroyed in the beginning of the sixth century B.C. In this way the Nabatæans mastered the most important world-trade routes and began to succumb to the influence of the civilization not only of the Edomites, but of all states with which they had trade connections. In the last century B.C. and the two first A.D. the Nabatæans concentrated in their home nearly the whole world trade. Petra, the capital of the Nabatæans, situated at the crossing of two caravan roads, was already in the second millennium B.C. a trade centre. To this conviction I have been led by my studies in the Sinaitic peninsula and in the Hejaz, in which the Israelites dwelt for about forty years, and have located the town Kadesh in the near neighbourhood of the later Petra. At Kadesh two caravan roads crossed: the one ran south and north along the western slope of the Biblical mountain Se'ir toward Palestine; the other east and west toward Egypt. From this capital the Nabatæans endeavoured to master, as far as possible, the great trade routes in order to secure the safety of the large caravans. Thus they became lords not only of the Sinaitic Peninsula, but of Damascus, and in the interior of Arabia—which country I have been exploring since 1908—I found many traces of their activity.

In the oasis Adumu, the present Jauf, they had their governor, and from

it their troops protected two roads: the one leading to Seleukeia in Babylonia; the other following the eastern border of the sandy desert El Nefud toward the oasis El Jera'a, the classical Gerrha, on the Persian Gulf. Yet more important was the road uniting Petra with the state of the Mineans in which the Nabatæans founded several colonies. The remains of the splendour of these colonies called to my mind the monuments of Petra.

The commercial and political influence of the Nabatæans awakened the jealousy of the Romans, and in the year 105 A.D. their capital, Petra, was incorporated in the Provincia Arabia. Thus the Nabatæan power vanished; their troops on the stations of the world-trade routes were either withdrawn or weakened; the trade caravans, for lack of the necessary security, changed their direction and proceeded towards the Persian Gulf and Babylonia; Palmyra began to grow, Petra to decline. In the seventh century A.D. Petra vanished.

The monuments shown to us by Sir Alexander Kennedy are the best evidence of the high degree of the Nabatæan civilization, but other records also witness to their importance. The classical authors praise the Nabatæan agriculture; and the modern traveller, exploring the vicinity of their colonies, has often occasion to admire their irrigation works and terrace gardens. Of Nabatæan literature, unfortunately, nothing has been preserved, although we find their inscriptions not only in the neighbourhood of their native country but in all the more important harbours of the Mediterranean. From their inscriptions we learn that the Nabatæans were Arabs, and that Aramaic, the commercial language of that time, mixed with Arabic words and phrases served as their monumental language. They adapted the Aramaic alphabet in such a way that it approached the cursive script. This cursive quality explains why the Moslems formed their alphabet from it, which not only the Arabs but also the Persians, Turks, and Malays use to this day.

My studies of the primitive history of the Israelites strengthen in me more and more the conviction that the countries governed by the Nabatæans had a great influence on the evolution of the Biblical religion. So far we have nowhere found in the vicinity of Palestine as finely built Semitic altars as in Petra, and these altars seem to illustrate those mentioned in the Bible. Both in Petra and her colonies we have found many stone symbols of different gods. They also call to mind several Biblical phrases, and with them the Ka'aba of Mecca, where was a Nabatæan colony, is perhaps connected. The Nabatæans possessed many gods, but from the manner in which they expressed themselves about them, we can judge that only one was the very God, the others being more or less the symbols of his various qualities, and later patrons of single colonies. The proper name of the highest, or, if it is possible to call him so, the only God of the Nabatæans, has not been preserved. They called him Du Sara, the Lord of the mountain district of Spara, the Biblical Se'ir. Since the Nabatæans were Arabs, it is certain that their highest god was Allah, the Hebraic Elohim, the same whom their neighbours, the Midianites, worshipped as their only or at least highest God. In the main oasis of the Midianites the Nabatæans founded their colony known to the classical authors as Midiama. The Biblical accounts of Mount Sinai or Horeb point to this centre of the tribe of Midian, where I found the temple erected by the tribe Tamud in the land of the Midianite tribe Efah. There the Midianite priest Jethro served the only God Elohim, whom the Israelites began to worship under the name of Jehovah.

From the outline I have given, it is evident that the Nabatæans were an

important factor in the cultural evolution of mankind. Therefore I suppose that every one present will agree with me when I express our best thanks to the Royal Geographical Society for having given us the opportunity of learning something of the civilization of the vanished Nabatæan nation.

Dr. H. R. HALL (Deputy Keeper of the Egyptian and Assyrian Department, British Museum): I have been asked to say something with regard to the Egyptian and Assyrian style of the architecture, if one may call it so, of the Nabatæans of Petra, of which we have seen examples in Sir Alexander Kennedy's fine slides. What struck me about it (and I dare say it strikes all those who are acquainted with Egyptian art) is that curious combination of the heavy Egyptian *cavetto* cornice with the Assyrian crow-steps above it. That seems to me to be rather a suggestion of the character of the art of these people; like that of the Phœnicians, it borrowed elements from both the two great civilizations, one on either side of them. In the rock façades we saw the Egyptian *cavetto* cornice and the Assyrian crow-step; or we saw some with the Assyrian crow-step alone; or sometimes a thoroughly Greek pedimental doorway. Evidently these last must come, at any rate, as late as the Ptolemaic period, if not later. But the *cavetto* cornice, as we saw it, on these façades seems to me to be of the type which is associated in Egypt with the Psammeticid or Saïte age, with the twenty-sixth Dynasty. That type of cornice goes as far back as the Old Kingdom, and 3000 B.C. of course. But the Saïte version of it can be differentiated from the older by certain *nuances* visible to the accustomed eye. The Nabatæans, apparently, came into occupation of the ancient Edom, in which Petra stands, after the captivity of the Jews (596 B.C.) enabled the Edomites to occupy Judæan lands. The Nabatæans came in after the Edomites had gone out. That is about the time which I should ascribe these Egyptian cornices, about the seventh to sixth century B.C. But you must remember that the Egyptian connection with the land of Edom is very much older than that, and the land of Adumu is mentioned right away back in Egyptian history; the Egyptians had constant communication with the Edomites in Edom; and under the Priest-kings, for instance, at the time of Solomon, and a little later, under the Bubastites, we know that the Kings of Edom had marriage alliances with the Egyptian Pharaohs. The Egyptian princess Mehetabel, for instance, married King Hadad II. about 1000 B.C. Therefore we do not quite know how far the Egyptian influence on architecture may not be taken back; but also we do not know whether Petra was older than the Nabatæan occupation at all, and the Egyptian cornices do not look much older.

With regard to the Assyrian influence, which we undoubtedly see in these crow-steps, that is quite natural. It came from the other side. We have mention of these people in the time of Ashurbanipal (seventh century), and later on, in the sixth century B.C., we find that the Babylonian King Nabanidus is mentioned in one of the chronicles as having invaded the land of Edom. My junior colleague at the British Museum, Mr. Sidney Smith, tells me he has recently noted a cuneiform tablet in the Museum which contains an account of the occupation of the city of Teima by that same king, which may have been either not far away from Petra, or may have been the modern oasis of Teima to the south, in the northern Hejaz. It shows that the Babylonians had then their attention considerably directed towards that part of the world, no doubt with the idea of controlling such important trade routes as those that met at Petra, and later made the fortune of the Nabatæans.

I do not think I have more to add, although one might go on talking about

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AIR MOSAIC OF
PETRA

Photographed 1923 by the
Royal Air Force, Palestine Command,
Maj. Gen. Sir H. H. Tudor, K.C.B., C.M.G., Commanding.

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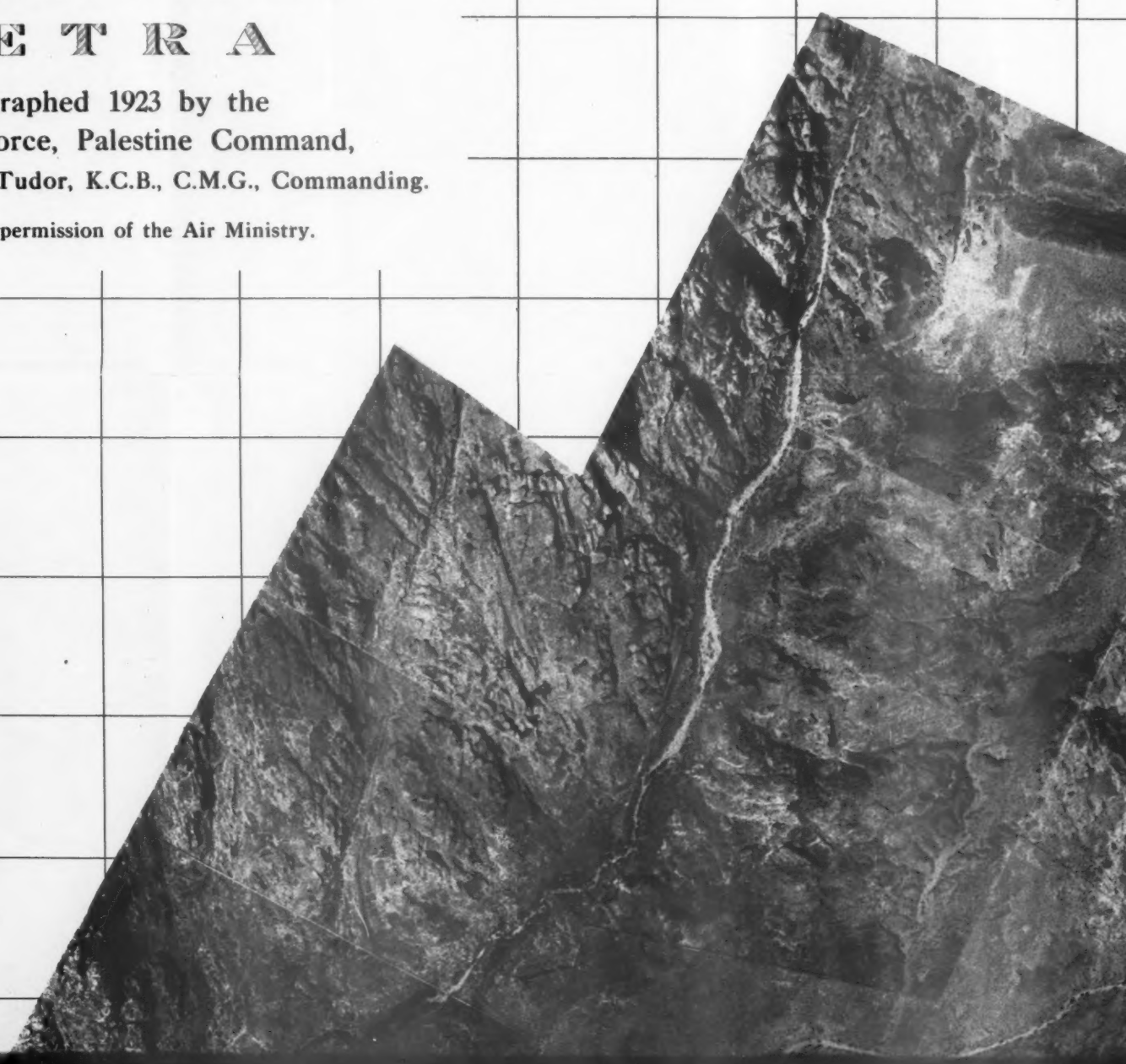

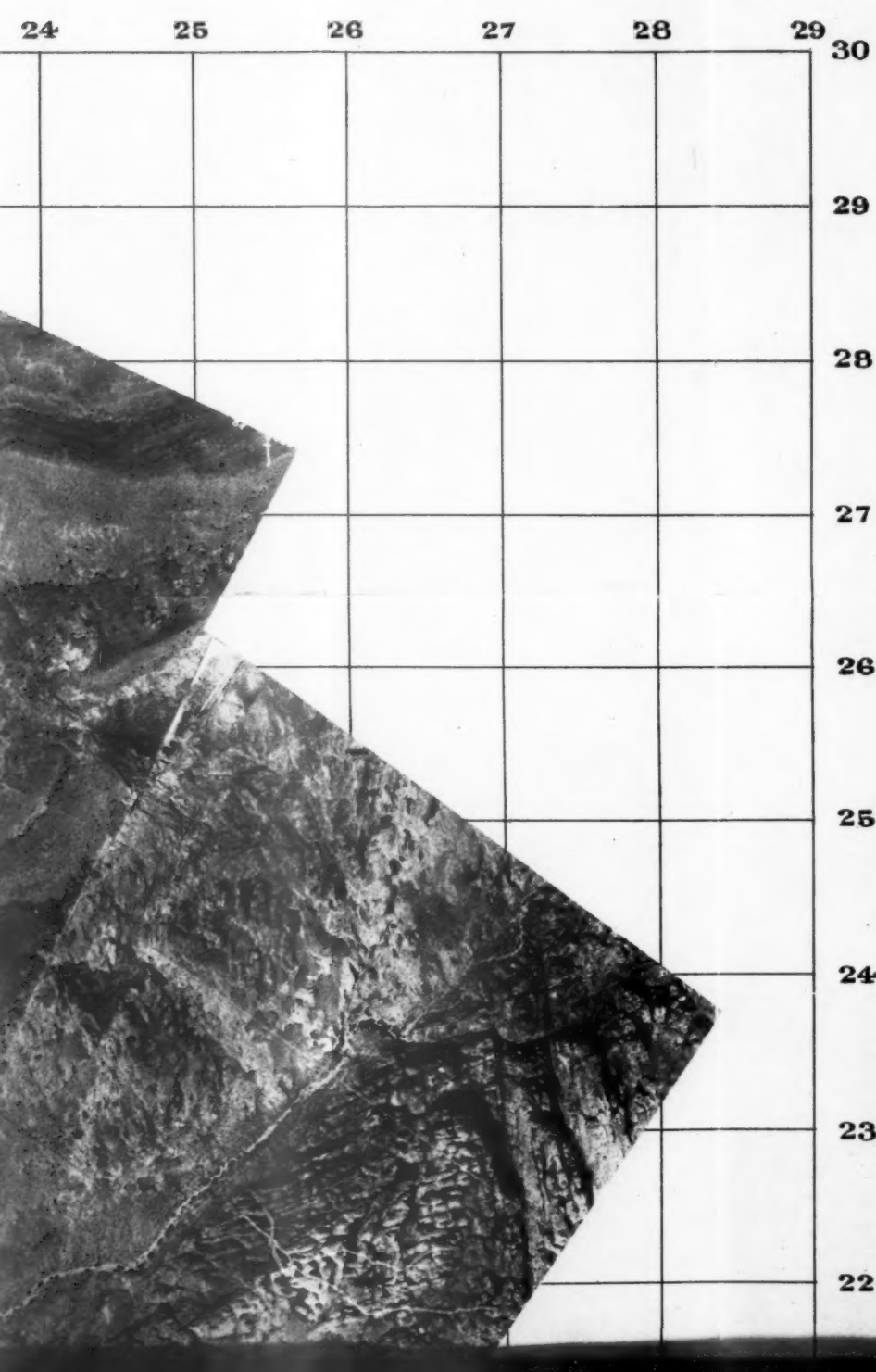
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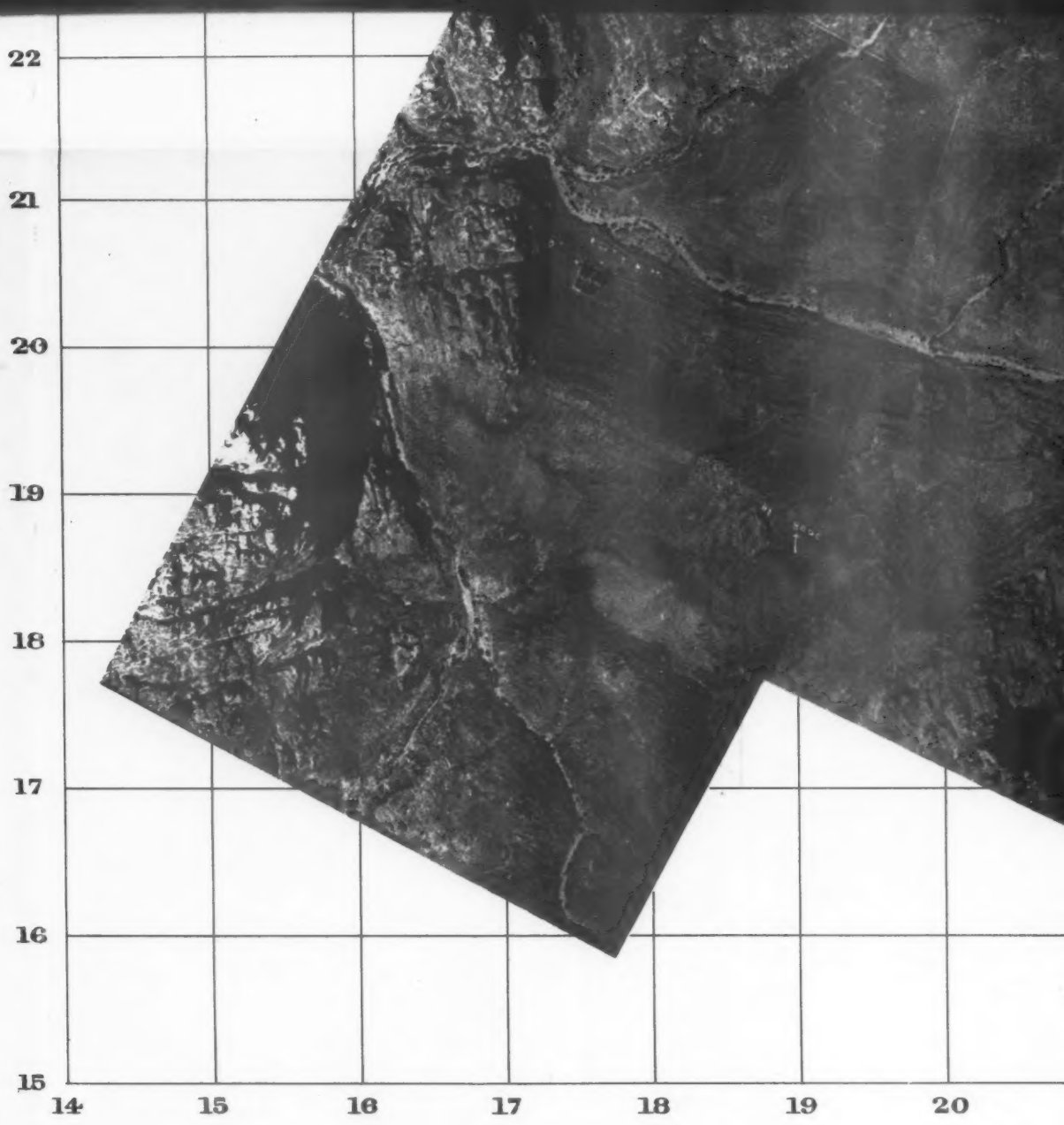

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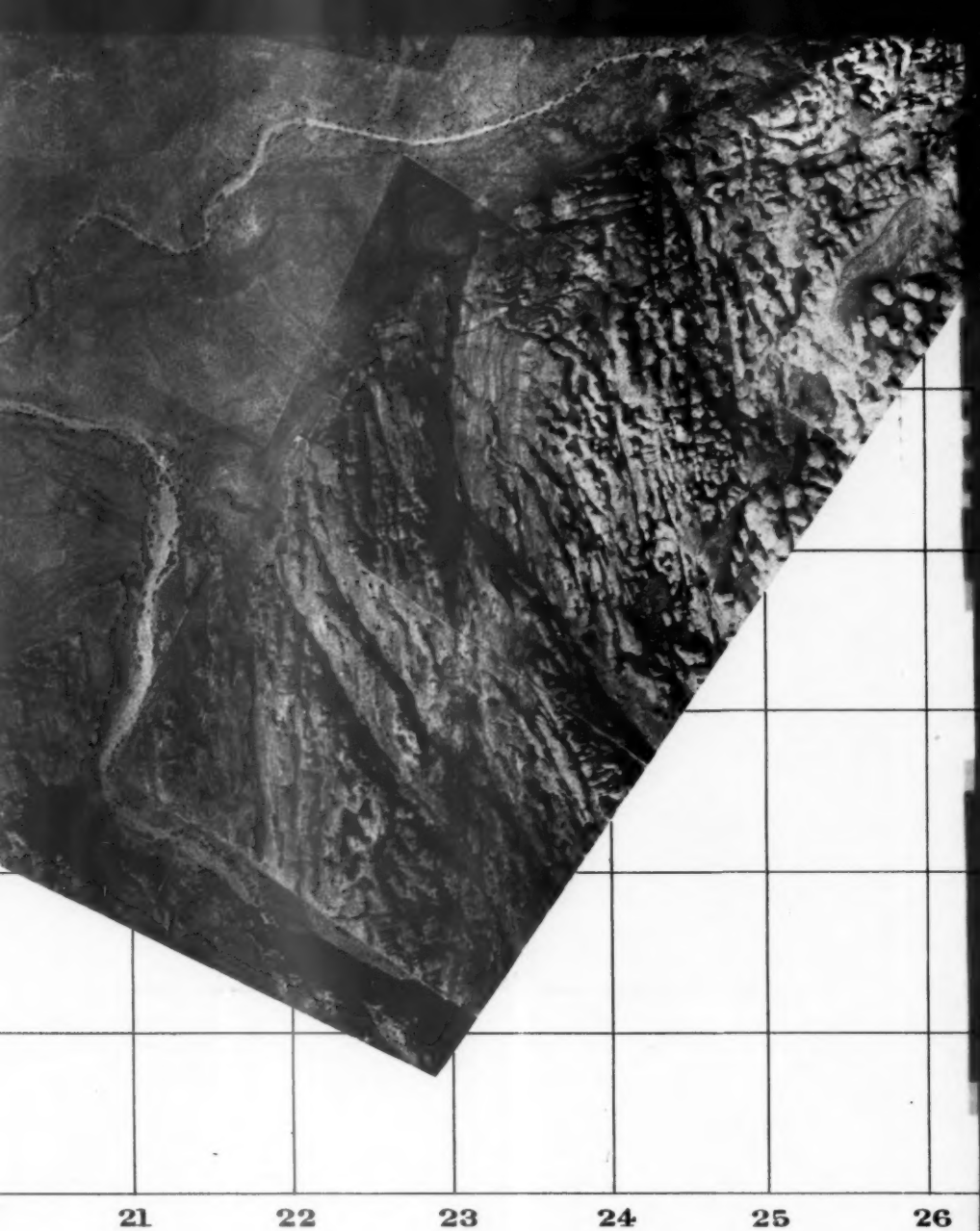

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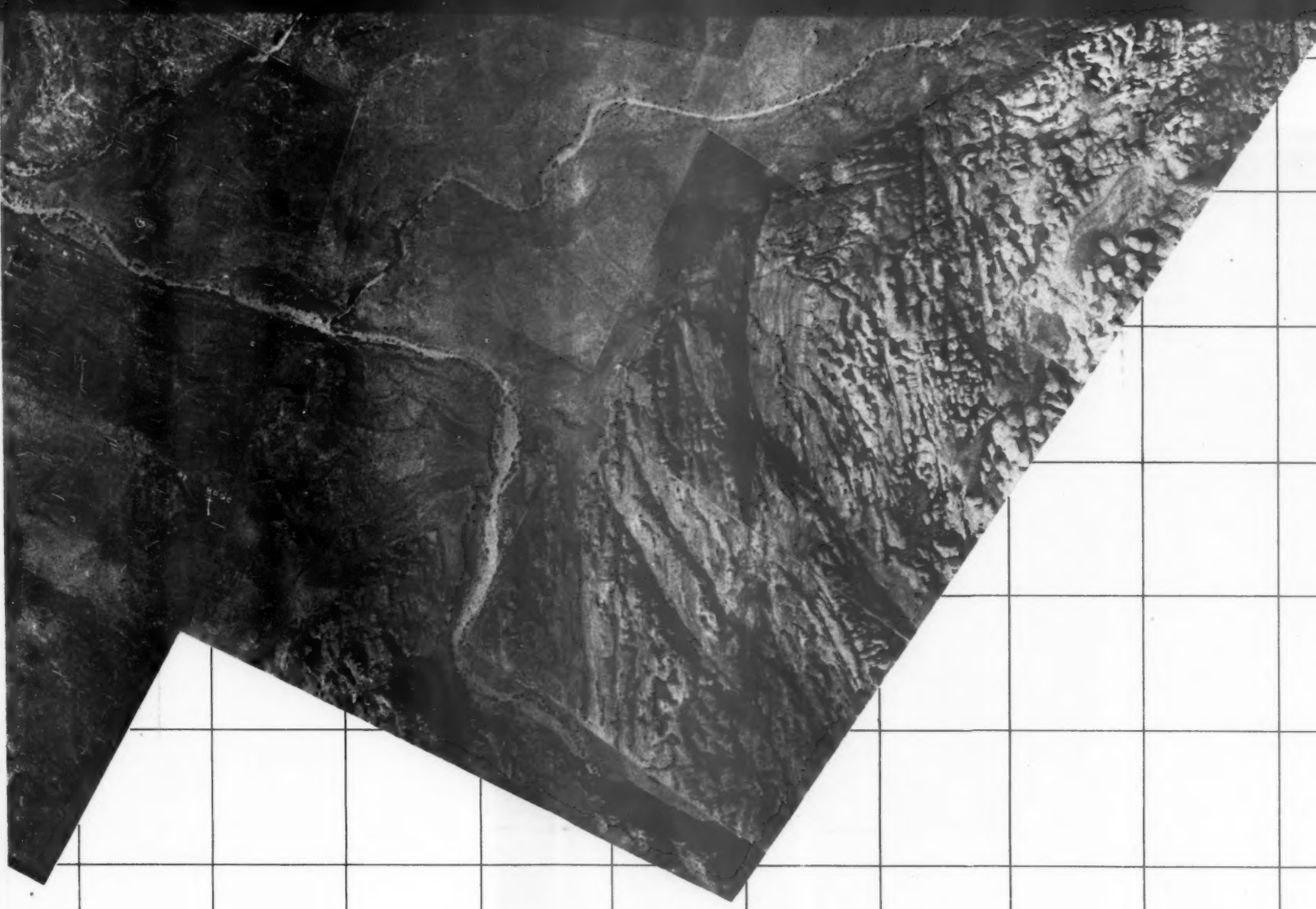

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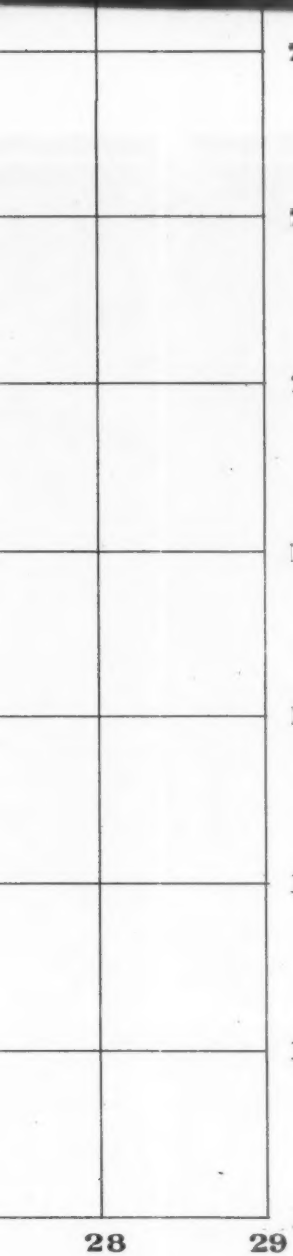


Grid References

15·5 : 19·0			*El Biyara (Pl. 5)*
16·2 : 20·6			*One of the older Sacella*
16·5 : 21·3			*Es Siyagh ravine (Pl. 9)*
17·0 : 20·7			*El Habis (The Acropolis) (Pl. 5)*
17·2 : 20·9			*Chamber on El Habis*
17·6 : 20·5			*Roman Temple (Pl. 6)*
17·3 : 23·3			*Entrance to Deir gorge (Pl. 5)*
18·5 : 19·9			*Roman streets*
21·2 : 19·5	*to*	18·0 : 20·6	*Bed of Wadi Musa*
18·4 : 23·4			*High place (Pl. 3)*
18·3 : 23·5			*Wall with niches*
20·3 : 17·5			*Zebb Atuf (obelisk ridge) (Pl. 12)*
20·0 : 23·8			*Early "holy place"*
20·6 : 17·3			*The Theatre (Pl. 13)*
21·0 : 18·0			*Northward bend of Es Siq*
21·0 : 24·2			*Tomb with Nabataean inscription*
21·4 : 16·7			*Chamber (Pl. 10)*
21·5 : 17·8			*Monument (Brunnow 781)*
21·7 : 16·7			*Block towers*
21·9 : 19·1			*Urn Temple*
21·8 : 19·4	*and*	24·5 : 21·8	*Classical tombs in North-east wall*
22·1 : 19·8			*Palace Tomb*
22·5 : 16·0			*Entrance to Es Siq*
22·3 : 18·2	*to*	25·0 : 21·6	*El Khobza*
22·5 : 19·5	*to*	25·5 : 22·5	*The red sandstone*
25·5 : 20·5			*The white sandstone*

PETRA
Kennedy

Petra for a long time, but if I may echo what my chief, Sir Frederick Kenyon, has said with regard to excavation, I may say that as Honorary Secretary of the Egypt Exploration Society and as Chairman of the Executive Committee of the Palestine Exploration Fund, as Sir Frederick has given me this opportunity, I will, with Lord Ronaldshay's permission, appeal for subscriptions for the work of these two societies. And I have no doubt that Sir Frederick himself will be most willing to receive contributions for the British Museum work at Ur of the Chaldees, now being carried out in conjunction with the University of Pennsylvania.

In conclusion, I wish to add my thanks to those of the rest of us for the fine pictures which Sir Alexander Kennedy has shown us. They have given us an admirable idea of Petra. Sir Alexander has also rightly directed our attention to the older monuments of the Nabatæans rather than to the meretricious "Spanish-Renaissance-like" products of provincial Roman bad taste, which hitherto have more or less monopolized the attention of visitors to and photographers of Petra. One can only sympathize with his youthful enthusiasm in the cause of archæology, and cordially wish him success in his further investigation of Petra.

The PRESIDENT: I do not propose to add anything to the discussion which has taken place, but merely, on your behalf, to join with the other speakers in expressing our gratitude to Sir Alexander Kennedy for the most interesting lecture which he has given us.

THE WESTERN ELBURZ AND PERSIAN AZERBAIJAN

Captain L. S. Fortescue

Read at the Meeting of the Society, 11 *February* 1924.

A PEACEFUL student of the classics on the banks of the Isis in the spring of 1914, I little thought that the autumn would find me bound for the East with a Territorial Battalion. But such was the fortune of war. Stationed in Northern India until the spring of 1917, I was then transferred to the Persian Gulf and the long-drawn-out misery of the Mesopotamian hot weather. During the ensuing year I thrice made the long journey of some 300 miles from Basra to Baghdad on horseback, and the sight of the Pasht-i-Kuh, standing out as a long rampart all along the arid monotonous plain of the Tigris, made me yearn to escape to the distant and mysterious highlands of Persia, with their alluring prospect of varied scenery and cool mountain air.

Having thus made Persia my goal I turned to the study of Persian—a step in the right direction, as a sympathetic commanding officer obtained for me the desired opportunity in 1918. I was sent to Persia, and attached to Norperforce as Assistant Political Officer at Kazvin until 1920, when I had the good fortune to be detailed to compile a Report for General Headquarters Baghdad on the region of North Persia at that time occupied by the British Forces. The approximate boundaries

indicated were: from Bandar-i-Gaz, near the south-east corner of the Caspian, to Tehran, Saveh, Hamadan, Bijar, Mianeh, and the Caspian.

I shall not venture into the troubled arena of politics and policies, but I will endeavour to give you the general impressions of a traveller in the Elburz Mountains and in the south-eastern districts of Persian Azerbaijan. In the early spring of 1920 Captain Noel, starting from Tehran, crossed the Elburz, still bleak and inhospitable at that season, to join me on the shores of the Caspian, where he travelled with me for six weeks. In his paper read to the Society in January 1921 he described and illustrated these Caspian Provinces.

In preparing my paper for this evening I have refrained from going over the same ground; my purpose will be to describe to you in some detail the valleys on the south side of the watershed of the Elburz, where I shall not have occasion to overlap with any part of Captain Noel's paper except in the valley of Nur; then my narrative will pass on to an entirely fresh area, which I have traversed in a journey from Manjil up the valley of the Qizil Uzun through south-eastern Azerbaijan by Mianeh to the borders of Garrus.

This area, with which my Report was to deal, is some 400 miles long and 200 miles broad. Apart from the familiar lines of approach to Tehran, namely the Russian metalled roads from the Caspian and from Hamadan, and the unmetalled road from Tabriz *viâ* Mianeh and Zinjan, the country is traversed by camel and mule tracks of varying degrees of badness.

While Assistant Political Officer in 1920 I had already been able to visit the regions north of Tehran and of Kazvin respectively. But it was the Report entrusted to me by General Headquarters Baghdad that gave me unparalleled facilities for travel in this area. The route shown on the sketch-map shows my longest journey of just about 1000 miles on horseback, from the middle of March 1920 until the end of June. It enabled me to spend the spring in the Caspian Lowlands, and the early summer in the Highlands. The map does scant justice to the difficulties imposed by nature in the shape of the great mountain chain of the Elburz, and the awful quagmires and impenetrable thickets and thorns of the Caspian Provinces.

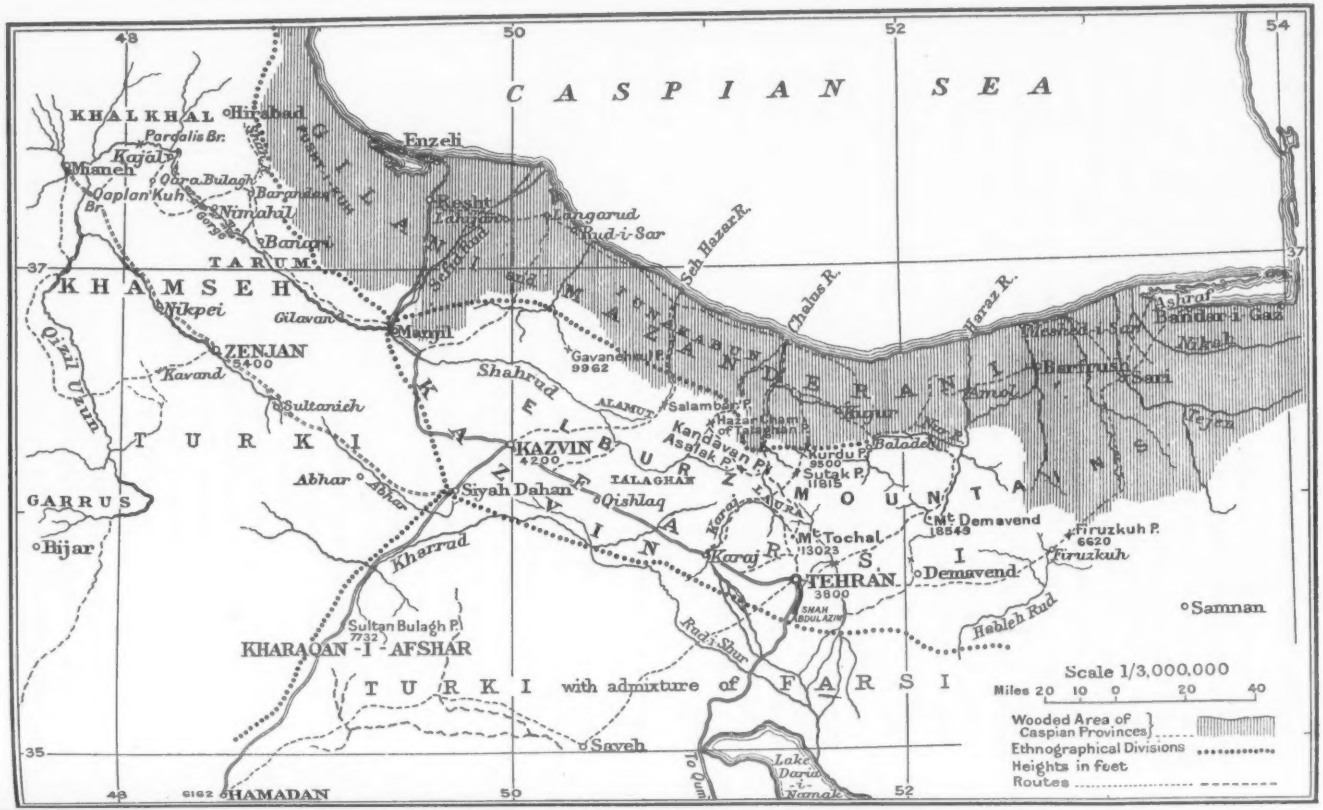
The name "Elburz" is applied by geographers to the whole mountain barrier which runs round the south and south-west shores of the Caspian, from Khorasan in the east to Azerbaijan in the north-west, cutting off Irak, as the Persians loosely term the treeless plateau country of the Samnan, Tehran, Kazvin, and Zenjan plains, at an elevation of 4000 to 5000 feet above sea-level, from the Jangal of the Caspian Provinces. The natives, however, of these mountains limit the name Elburz to a single ridge in Alamut. They give local names to every prominent ridge or peak, but they have no comprehensive name for the whole system.

The gap of Manjil by which the Sefid Rud, the "White River," breaks through this range is traversed by the Russian road from Gilan to Tehran. Further east the Elburz is crossed by the low and well-defined pass of Firuzkuh, which, except after very heavy falls of snow, remains open throughout the year. This pass at an elevation of 6620 feet involves a very slight ascent from this southern side, and the descent towards the Caspian is long and fairly gradual. It affords a natural line of access between the plateau of Persia and the Caspian littoral, and would not present any great difficulties to the construction of a metalled road. Elsewhere the mule routes radiating from Samnan, Tehran, Kazvin, and Zenjan zigzag laboriously up to the summit of ridges at heights of 9000 feet to 12,000 feet above sea-level.

On the section of the Elburz between the Firuzkuh pass and the gap of Manjil there are ten such routes, and of six I have personal experience. They are rendered impassable by snow for one to six months every winter —according to their altitude and exposure—and none of them could be improved and rendered passable for camel, much less for wheeled transport, without prodigious labour and expense. The most important of them, the Harhaz route from Tehran to Amol, has the merit of crossing only a single ridge of 8700 feet to reach the valley of the Harhaz, which breaks through the central Elburz range by a great gorge; but this track is subject to scouring from the slopes of Demavend, which would render the upkeep of a road extremely difficult.

North-west of Manjil there are three routes from Zenjan, one from Mianeh, and one further north from Ardebil to Astara. Disturbed political conditions prevented me from reconnoitring the Zinjan routes over the ridge between the Qizil Uzun valley and Gilan, but though these passes are less elevated and snowbound for shorter periods, local reports described them as very difficult. Of the Mianeh route *viâ* Hirabad, I was unable to obtain any information except that it was abandoned on account of the prevailing insecurity. The Tabriz–Ardebil–Astara route, the most important of the routes north-west of Manjil, lay outside my area. The distance along most of these routes from the point where they enter the mountains on the plateau side to where they debouch on to the coastal lowlands is approximately 100 miles.

To commence our visit to the mountain valleys, let us go up the valley of the Karaj river through the district of Laura. This valley is separated from the headwaters of the Chalus, draining north into the Caspian, by the single pass of Kandavan, which would at first sight appear to indicate it as the easiest line of approach from the neighbourhood of Tehran to the Caspian. This route is rendered all the more tempting by the accessibility of the Karaj bridge on the Tehran–Kazvin road, where the Karaj river debouches on to the plain, which is the jumping-off point for a journey up the valley. The first two stages of



Sketch-map of Western Elburz and Persian Azerbaijan, to illustrate Captain Fortescue's paper.

the track above this bridge are, however, so difficult that the muleteers prefer a *détour* involving an extra pass *viâ* the Jajarud, or over the shoulder of the Tochal mountain, and these stages were a lesson to me scrupulously to avoid any route described as "bad" by local report. An Elburz route worse than the average must be bad indeed!

A short distance above the bridge the valley is shut in between mountains of 10,000 to 11,000 feet. The river breaks through a series of defiles with few open spaces or villages as far as the junction of the stream from Shahristanak, where the Jajarud and Tochal routes join the valley of the Karaj—or the Laura, as it is now named—and follow it up to the watershed. Above this junction the valley is still wild and rockbound, but it has some picturesque nooks, as at Tangi Khasil, where a wayside teashop (qahvehkhaneh) nestles under the beetling cliffs and serves as a club for the adjacent villagers to meet and discuss the latest news and gossip brought from town or Caspian seaboard by the passing "charvadars" (muleteers), who are still the newsagents and letter-carriers of these remote mountain valleys, as they were in the days of Darius. It is a spot to tempt the angler and the artist, as the Karaj, fed by cool clear mountain springs, is the home of an old friend whom I had not expected to meet in Persia—the brown trout, the *kizil ala*, or "red spots," as the Persians call him.

Above Tangi Khasil the valley broadens slightly and affords room for numerous strips of cultivation. In these confined valleys of the Elburz it is not lack of water for irrigation, as on the plateau of Persia, but lack of level ground that limits cultivation, and viewed from above the patches of verdure clinging to the river-bank appear tiny in relation to the whole mountain area. Besides their immensity, the absence of man and of civilization seems one of the most striking features of great Asiatic ranges, like the Himalayas and the Elburz, which differentiates them from the Alps, where one looks down into fertile highly cultivated valleys.

Nature is not kind to the efforts of man in the Elburz valleys. In the summer of 1919 there was a terrific deluge, which swept down these bare mountain sides and inundated the poor little fields, levelled and cleared at the cost of so much labour, a foot deep with boulders and *débris*.

The peasantry do not live in scattered cottages, but are grouped in small villages averaging fifteen to forty houses, surrounded by walnut and poplar trees, which provide fuel and rafters for roofing for the villagers, and welcome shade for the traveller's bivouac in summer.

The crops produced in the adjacent fields are wheat for the inhabitants, and lucerne and barley for their mules. Not only is the cultivable area very limited in extent, but the soil becomes very impoverished and gives a poor yield, the crop—to use the Persian mode of reckoning—seldom exceeding five to six times the quantity of seed sown. The

Sketch-map of Western Elburz and Persian Azerbaijan, to illustrate Captain Fortescue's paper.
HAMADAN

lion's share often falls to the landlord, who takes his rent in kind. The harvest is divided on the threshing floor between landlord and tenant; the method of division varies in different localities, but the following is typical: The harvest is divided into five shares—one for the land, one for the water, one for the seed, one for the oxen that plough, and one for the labour. The first three are usually the property of the landlord, the last two of the peasantry.

The land is still the basis of wealth; it is held for the most part by a small number of big proprietors, who not infrequently indulge in landgrabbing. A powerful neighbour may cut off the supply of irrigation water, and in various ways make life so unpleasant for the small holder that eventually he is forced to sell on the great man's terms. The Persian Revolution of 1906 and the Constitutional system, that has supplanted the autocracy of the Shah, have hitherto enhanced rather than diminished the power of the landowning aristocracy, who dispose of the votes of their illiterate peasantry and consequently control the elections, while they themselves have been freed from the control exercised by the Shah under the ancient *régime*. Recent political developments in Persia and the increasing power of Riza Khan may modify this state of affairs.

Persian landowners might well entertain misgivings about the Bolshevik contagion and fear its spread into their country from the Caspian, but the Persian peasant has a direct individual interest in the soil under the system of land tenure described. Provided the crops do not fail, and he is not too ruthlessly fleeced, he is essentially easygoing and peaceful, and the Bolshevik propaganda of the last few years—with the exception of the anti-British part of it—has failed to make any appreciable headway.

In most Elburz villages the crops barely suffice for the maintenance of the villagers, whose standard of living is much higher than that of the peasantry of Northern India, and provide no surplus for the purchase of clothing and other needs. The villagers consequently augment their resources by flocks of sheep and by the carrying trade, which passes along these mountain valleys. It consists in the interchange of commodities between the plateau and the Caspian Provinces, of wheat, barley, dried fruits, and salt from the former, and of rice, charcoal, dairy produce, fish, and oranges from the latter, the towns of Tehran, Kazvin, and Zenjan being the principal distributing centres. The high cost of transport in Persia is grievous, and the value of a mule-load of rice in Tehran is treble its value in Mazanderan, and the price of charcoal is increased tenfold.

The village is the administrative unit, and has its *Kadkhuda*, or headman, who is appointed by the landlord (*Arbab*), usually in consultation with the peasantry, and is the former's agent for the collection of his rent. If ownership is divided between two or more landlords, a

separate kadkhuda is appointed for each of the different properties, and in villages divided into small holdings, the kadkhuda is appointed by the Government for the collection of the land tax. In addition to the kadkhuda some of the larger villages appoint as their representatives a number of elders, *Rish Safid* (Greybeards), who take the side of the villagers in case of disputes between villagers and kadkhuda or landlord. An important personage in the village community is the priest, *Mujtahid* or *Akhund*, who conducts marriages and burials, draws up and countersigns all deeds, etc., and settles disputes between villagers. Only serious cases are taken to the Governors of Districts, into which the provinces are divided, whose authority is very little felt. The provincial governor represents government in his capital, which he rarely if ever leaves, and deputy governors seldom tour through their districts. It is the landlord, his agents, and the priests who are the principal power in the countryside.

The visible signs of the religion of the villagers are the whitewashed *Imamzadeh*, or Shrine, which is to be seen in nearly all Elburz villages, and, during the month of Muharram, the *Taziyehkhani*, or Passion Play, representing the events in the lives of the Imams and Prophets. The apparition of myself, and even of my camera, was not resented at these plays, though the ladies discreetly veiled. Muharram celebrations in the villages are a much simpler affair than in the cities of Persia, where the religious enthusiasm of these Sh'iah Muhammadans reaches its climax on the tenth day of Muharram, the anniversary of the slaughter of Husain and his followers on the plain of Kerbela, which is commemorated by the well-known processions of the " Followers of Husain " (*Shah Husainiha*), bareheaded, clad in white, and bloodstained from the blows of swords and knives.

During all my travels in the Elburz I always met with friendliness and hospitality. In summer I used to bivouac in the shade of walnut or poplar trees, but in inclement weather the kadkhuda would always find a room : and in a good-class village house, with a blazing log fire, one used to be very comfortable. Anon, however, one might be overtaken by wind and rough weather, where the accommodation was of a humbler type. I well remember arriving late on a stormy autumn evening at a poor village on the Caspian side of the watershed. With some difficulty we were installed in a small cottage. Being the fortunate possessor of a camp bed, I slept peacefully on this citadel, while my less fortunate companion dossed down on the felts spread on the floor and spent a night of martyrdom. In the morning he looked like a measles case, so innumerable were the bites of the insects who had derived nourishment from him.

The upper reaches of the Karaj valley, at a height of over 7000 feet above sea, are a very pleasant *Yailaq* or Highland summer quarters, requented by the inhabitants during the hot season. In autumn the

majority of the villagers, to escape the rigours of winter, cross the watershed to lowland winter quarters, *Qishlaq*, along the Caspian littoral. During the winter months the Elburz villages, and in summer the lowland villages, are semi-deserted, and the traveller has to reckon with difficulty in obtaining supplies and accommodation as well as with climatic difficulties if he has occasion to traverse either of these regions during the inauspicious season.

After my long journey I spent July and August 1920 working at my Report at a summer camp in the Karaj valley. The atmosphere was of a clearness and purity which I have only seen equalled in Iceland or in the Himalayas in autumn after the rains, and the climate was delicious, with a range of temperatures between 50° and 70°, whereas Tehran during these months has an average range of 70° to 100°. The site of my summer camp was a little plateau behind the village of Nisa, where Nasir-ud-Din Shah used often to camp on his way from Tehran to his favourite hunting ground of Kalardasht, described by Captain Noel. It overlooked the valley and the great bare mountains beyond, and the open view induced a delicious sense of space and freedom, which is often lacking in mountain valleys. My Persian servants did not share my appreciation of this secluded camp; a sowar, who had served me well, heard rumours of a Bolshevik–Jangali raiding party in the neighbourhood of his village, and next morning he had disappeared; and my cook, a Tehrani, was restrained with the greatest difficulty from running away to the amenities of town life. Rumour was rife after the withdrawal of the British troops from Manjil, but no raiding party was ever reported within several stages of my camp.

From the Karaj valley there are several tracks across the watershed to the Caspian littoral. The main mule route leaves the valley at Gachisar, crosses the ridge of Kandavan (9460 feet), and descends the valley of the Chalus. The view from the ridge itself is not very extensive, but some 3 miles further one has from the road a magnificent view over the forest-clad ravines of the Chalus, dominated by lofty mountains. This view, and that from the Nur ridge of Damavand to the south and of the Caspian to the north, are most striking examples of Elburz scenery. From Gachisar to the Caspian is four stages, the first three of which are described by Colonel Beresford Lovett in the *Journal* of the Royal Geographical Society for February 1883. The road has since then been allowed to fall into disrepair, but it is used by numerous mule convoys.

Another route from Tehran to the Caspian ascends the Jajarud valley and crosses the Dizin pass (10,490 feet) to the headwaters of the Karaj, which it descends to within 5 miles of Gachisar, and then turns north up a side valley to the Sutak pass. A footpath goes up the valley from Gachisar to join this route, but it is too bad for a loaded mule. The Sutak pass at 11,315 feet is closed by snow from November to June.

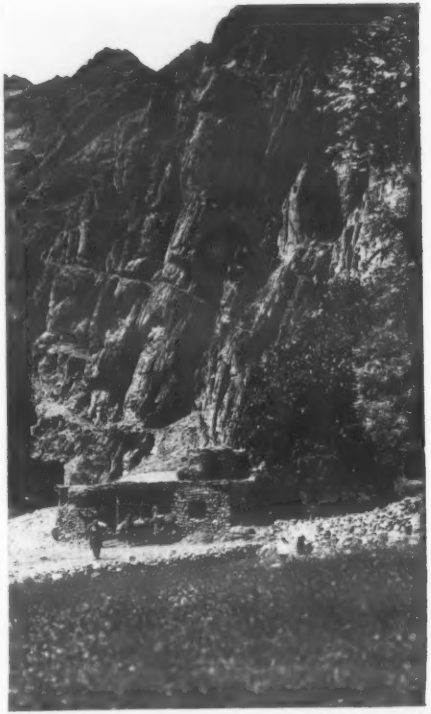
WINTER TRAVELLING ON THE PERSIAN PLATEAU

SNOW ON SUMMIT OF THE HAZAR CHAM

SUMMIT OF THE HAZAR CHAM OF TALAGHAN

ASCENT TO THE SALAMBAR PASS FROM THE NORTH

THE ELBURZ IN SPRING



WAYSIDE TEASHOP IN THE KARAJ VALLEY

The ascent on the southern side is extremely steep, but on the north the descent to the Nur valley is not difficult. A second pass, named Kurdu, about 9800 feet, leads on from the Nur valley to Mikhsas in the Pul district.

To the west the Karaj area is divided from the area draining into the Shahrud, which flows into the Sefid Rud at Manjil, by the easy Asalak pass (9400 feet), which is approached by a tributary valley joining the right bank of the Karaj, 2 miles downstream of Gachisar. In October 1920, after leaving my summer camp, I crossed this pass, and then turned north up a tributary of the Talaghan stream to the pass known as the Hazar Cham of Talaghan, at a height of about 12,000 feet. It is one of the loftiest passes in the Elburz, and snowbound from November until the end of June.

I have never traversed the whole length of the valley of the Shahrud from Talaghan down to Manjil, but I visited various parts of it from Kazvin. The most interesting of my journeys in that area was from the Caspian to Kazvin, in the autumn of 1919. From the district of Tunakabun, on the Caspian littoral, the mule track ascends the misty forest-clad valley of the Seh Hazar to the Salambar pass (11,200 feet), the watershed between the Seh Hazar and Alamut.

The sombre valley of Alamut accords well with its associations as the fastness during the twelfth and thirteenth centuries of the "Old Man of the Mountains," the chief of the fanatical sect of the "Hashishin," who under the influence of the drug hashish specialized in disposing of their enemies by the way to which posterity has attached the name "assassination." There is, however, another aspect of the story of Hasan Sabah, which is difficult to reconcile with this desolate valley. The legend speaks of enchanting gardens, where the agents destined to carry out their chief's deadly behests were initiated into a foretaste of the joys of paradise. Impossible to picture paradise on the narrow summit of the barren crag where tradition places the fortress of Hasan Sabah! The use of the drug "hashish" is unfortunately widespread in modern Persia—in the Caspian Provinces, for instance, 30 per cent. of the people are said to be addicted to it and to opium—but the modern devotees of the drug have none of the ferocity of the ancient "hashishin."

West of the region I have been describing is the passage pierced by the Sefid Rud through the mountains below Manjil. Except for the area draining into the Caspian by this river, the whole of the drainage from the plateau either loses itself in the salt desert known as the *kavir*, the "dead heart of Persia," or makes its way to the far-distant Persian Gulf.

In June 1920 the Bolsheviks were in possession of the Caspian littoral, and I received instructions to continue my reconnaissance from Manjil up the valley and make my way to Mianeh. Following the left bank of

the river from Manjil I traversed the district of Tarum in three stages. Persian accounts describe the valley as fertile and productive of great quantities of fruit. There are fruit gardens—figs, plums, pomegranates, vines, etc.—around the villages; but this description of Tarum as a whole is, to say the least of it, exaggerated.

The valley is broad and open, bounded by hills rising from 3500 or 4500 feet above it. The river, being considerably below the level of the land on either side, is not utilized for irrigation, and all cultivation depends on tributary streams from the hills, which, especially on the left bank, are few and small; the aspect of the country is most desolate, the villages appearing as small oases in the wilderness. And such villages! The population has suddenly changed from Persian to Turkish.

The ethnographical divisions of this area of North Persia are roughly as follows:

South-east of Manjil the area enclosed by the Elburz, by a rough line from Manjil to Siyah Dahan, south-west of Kazvin, and continued thence to the south of Tehran, is Persian. The Mazanderanis and Gilaris, on the Caspian side of the Elburz, are as different from the dwellers of the plateau as their verdant forest country and its climate are different from the arid tawny hills and plains of "Irak"; moreover, while understanding Persian, they speak a variety of dialects. They are however of Persian origin, and the differences are due to geographical and climatic rather than to racial differences. But Azerbaijan and parts of the provinces to the south, in the area enclosed by the watershed to near Manjil, by a rough line thence to Siyah Dahan continued north-west of the Kazvin–Hamadan road, are wholly Turkish. South-east of this road there is an admixture of Persian, but Turkish predominates.

Of the towns Saveh is entirely Persian, though the villages within a few miles of it are Turkish; about a third of the population of Kazvin appears to be Turkish, and a smaller part of the population of Tehran. The transition from the Persian to the Turkish area is often surprisingly sudden. Manjil, for instance, is Persian; the next village of Gilivan, which we passed 17 miles higher up the valley, is Turkish, and we had difficulty in finding anybody who could understand Persian; for the remainder of my journey one of my Persian servants, who could speak Turki, had to act as interpreter.

There is a corresponding change in the name of the river; down-stream of Manjil it bears a Persian name, the Sefid Rud, or "White River," whereas upstream of Manjil it bears a Turkish name, the Qizil Uzun, or "Long Red River." The apparent confusion is presumably due to the different colour of the river at different seasons of the year. It is red when swollen with the snow melting on the Persian Highlands in spring and early summer, whereas when running low in autumn it changes to a grey or milky hue.

These Turks are descended from various bodies of invaders from Central Asia into Persia, such as the Ghuzz tribes who came in during the Seljuk period in the eleventh and twelfth centuries. After the Seljuks ensued the Mongol invasions and the rule of the Mongol Khans, who had their capitals at Maragha, Tabriz, and Sultanieh (near Zenjan).

The characteristics of the Turkish village population are radically different from those of their Persian neighbours, and the change of race is deplorable, from the point of view of the traveller. The Turki peasantry is sullen, boorish, and fanatical by comparison with the cheerful and quick-witted Persian, and the filth of their villages is worthy of their Mongol ancestors. They are avaricious and distrustful of strangers. In short, they seem to possess the bad without the redeeming qualities of the Persian, whom they regard with antipathy as a foreigner. This feeling is reciprocated in the Persian slang expression: *Tu be qadri Turk khar ye* ("You're as big an ass as a Turk"). These Turks of North Persia being Shi'ah are kept apart from the Ottoman Turks by religious differences.

The Turkish area is more disturbed than the peaceful Persian countryside. The following is an extract from my diary on 29 May 1920, the day after our departure from Manjil: "On nearing the village of Kariz we heard a good deal of shouting followed by shots coming from the direction of the river. One shot came decidedly near us, and we began to wonder what was happening, until some men ran up and explained that they were in search of a mule which had been stolen during the preceding night; seeing us on horseback they suspected us of being the robbers, and had consequently come in pursuit. This is the first occasion on which I have been taken for a horse-thief!"

Our first two stages through Tarum on May 28 and 29 were hot and exhausting. The cooling effect of the north wind, blowing up from the Caspian, ceases to be felt a short distance above Manjil, and in summer the heat becomes intense. Progress was slow, as there is no regular mule route up the valley, and we were following a succession of village-to-village tracks. The only carrying trade in this region is between Zenjan and Gilan, and on passing one of these routes we saw several convoys of mules crossing the river. Their loads were placed in a ferry-boat, but the animals swam and were carried a considerable distance downstream by the swift current.

Our third stage took us further from the river into a more pleasant country nearer to the watershed to Banari, commanding a wide view over the valley of the Qizil Uzun, where we were entertained by the Deputy Governor of Upper Tarum. Next morning we awoke to find the alarm had been given that Shahsavan horsemen were threatening villages 10 miles away across the hills, and our host had ridden off with his followers to protect his property.

The remaining stages of our journey, as far as Mianeh, were haunted

by rumours of Shahsavan raiders. These rumours never materialized, but they were sufficient to alarm the muleteers and to cause us much difficulty in obtaining transport; and nervous village sentinels let off sundry shots in our direction. Fear of the Shahsavans did not, however, incline the Turki villagers to be well disposed towards us, and we were often made to feel that our presence was unwelcome. My little party, of myself and another British officer, with a Ghurka orderly, two Persian sowars, and servants, was not large enough to inspire respect, especially at this time, when the news of the British evacuation of Enzali on the Caspian before the Bolsheviks was already widespread! The wholesome moral effect of a little force in this part of the world was shown one day by the passage just over our heads of a British aeroplane, presumably bound for Tabriz. A peasant, hitherto surly, supposing the unwonted visitor to have some connection with us, promptly became most attentive, and invited us to graze our horses in his best clover field.

Near Banari the natural feature undergo a sudden change. The wide open valley of Tarum comes to an end, and the Qizil Uzun flows through a winding ravine 2500 to 3000 feet deep. It appears to begin near Miayansarah, the junction of a small tributary called the Shahrud with the Qizil Uzun, and continues for some 50 miles through Khalkhal, to within a few miles of Mianeh. There is no track up the ravine, as the river runs against numerous spurs of cliff thrown down from the plateaus above, and villages are few and far between. It can only be crossed at a few points by stony tracks with gradients of 1 in 5 and 1 in 6. To the north and south above the brink of the ravine, and in striking contrast to its desolation, stretch fertile rolling uplands, 6000 to 7000 feet above sea, the finest unirrigated land for wheat and barley in this area.

From Barandaq, the next stage beyond Banari, the easiest and shortest way to Mianeh lies over these uplands on the north of the Qizil Uzun. The Shahsavan scare, however, rendered it absolutely impossible to get any muleteers to accompany us in that direction, and we were consequently obliged to pass to the south of the Qizil Uzun.

We crossed the river at Nimahil, a village of about thirty houses, with large fruit gardens, rice, wheat, and barley cultivation. The following is an extract from my diary of 2 June 1920: "The people of Nimahil seem more cheery and affable than the beasts of Barandaq, and understand some Persian. We sat under big plane trees—it was cooler than we had expected down at the bottom of this deep valley—until the men who work the *kalak* (raft) were reported ready. We then went through the gardens to the river-bank, which we followed upstream for ¾ mile. On the left bank was a strip of mulberry trees and crops, on the right barren scale and cliff, rising steeply from the water's edge. The big turbid torrent of the Qizil Uzun, some 50 yards wide and flowing at 6 or 7 miles an hour, looked very formidable, while a heavy thunderstorm

increased the dreary desolation of the scene. The raftsmen did not arrive until the storm was over, and were not ready to get to work before 4.30. The raft consists of a framework of wooden bars, about 12 feet long by 6 feet wide, with twelve inflated sheepskins fastened underneath, manipulated by one or two men with paddles. At each crossing it is swept some 160 yards downstream, and has to be carried up the opposite bank and ferried across, the round trip taking about twenty minutes. It took in all ten trips to transport our kit, saddlery, etc. The skins leak rapidly and need constant inflation. It is altogether a very primitive and tedious concern, much inferior to the hide rafts employed on Himalayan rivers. Finally our horses and mules were driven into the river in a frightened herd. They all swam strongly and crossed without mishap, much to my relief, as this was an event I had been dreading for some days."

We bivouacked for the night on the right bank of the river, and next morning climbed steeply up to the edge of the tableland at about 4500 feet, and then very gradually over undulating hills to nearly 7000 feet, The distance across the ravine from tableland to tableland appears to be between 3 and 4 miles as the crow flies. We were thankful to be back on the uplands with the Qizil Uzun behind us. Our troubles however were not ended. Overtaken by a heavy thunderstorm in the evening, we had to take refuge in a verminous village perched on huge manure heaps, whence our muleteers took the opportunity of absconding with articles of our kit. Immobilized by lack of transport I rode off alone 40 miles next day to Zenjan; thanks to the assistance of the governor, I returned with seven excellent mules, and we were able to resume our journey.

We passed several villages, the largest of which is Qara Bulagh. It is typical of this part of Azerbaijan, with only a few poplar trees to relieve its nakedness, squalid, and much more primitive than the Persian villages of the Elburz. These districts, moreover, have suffered severely from the prevailing insecurity and were terribly ravaged by famine and sickness in 1917–18. Some villages are now almost deserted, and everywhere ruined houses attest the decrease of population.

From Qara Bulagh we continued to Kajal, on the side of a deep valley descending to the Qizil Uzun ravine, where we had the good fortune to be well received and hospitably entertained by the owner of a fort dominating the village. From Kajal I was able to visit the bridge of Pardalis. A trade route from Zenjin to Ardabil used to cross the Kizil Uzun by this bridge, but the two central spans were breached several years ago to prevent the Shahsavans, who live north of the river, crossing to loot on the right bank. The protection thus afforded is only very partial, as the river is fordable at several points during the low-water season.

A second trade route from Zenjan to Ardebil crossed the Qizil Uzun

by a ferry and passed up the valley of the Shahrud to Hirabad. Both these trade routes were, however, entirely abandoned owing to the prevailing insecurity, and muleteers preferred to make a long *détour viâ* Mianeh. This increased lawlessness of the tribes has been one of the results of the Persian Revolution of 1906, the Constitutional Government in its early days having been quite unable to exercise authority over the tribesmen of Azerbaijan—and much less over those of Luristan and Southern Persia. It is only fair to add that the Swedish Gendarmerie established in 1911 had made considerable progress in pacifying the tribes of the south, but there, as in Azerbaijan the weakness and disorganization of the Persian Administration during the war had disastrous effects. Let us hope that Riza Khan may succeed in checking the raiding instincts of these rude tribesmen.

The ravine of the Qizil Uzun comes to an end some 8 miles above Pardalis, and the valley is wide and open as far as the junction of the rivers below Mianeh. Above this junction the river, now very much diminished in volume and very brackish from the salt springs in Garrus, is enclosed by a short gorge as far as the Qaplan Kuh Bridge on the road going north to Tabriz ; thence upstream it traverses a more open country. We struck the road close to the bridge and followed it over the Qaplan Kuh to Mianeh, the limit of the Turkish advance which threatened to cut the British line of communications from Baghdad to the Caspian in the autumn of 1918.

The town has given its name to the bug, the " argas Persicus," with which it is infested. The popular name for these pests is " Gharibgaz," which means " Stranger-biter," as the inhabitants of the places he frequents become immune to the severe form of relapsing fever occasioned by his bite. One is generally warned of their presence and counselled to adopt the native form of inoculation of swallowing one of these bugs in a pill of dough !

We reached Mianeh in the afternoon to find the streets deserted, as it was the month of Ramazan, and the long fast from sunrise to sunset reduces the inhabitants to a state of inactivity during the day. It is an inconvenient season for travellers, as no business is transacted until evening, and food is obtainable only by special arrangement. In the country, however, the peasants continue their daily toil in the fields without breaking their fast and without quenching their thirst—a severe test of endurance under the brilliant Persian sunshine during the long June days.

Lack of time prevents me from describing the remainder of my journey from Mianeh up the Qizil Uzun to the borders of Garrus, and thence to Zinjan ; and in part perhaps also lack of memory and inclination, for these last stages of my long journey were marred by heat, dust, flies, and sickness of man and beast. The grim gorges which the Qizil Uzun traverses through Khalkhal are less forbidding than the

dreary open valley into which we descended some 12 miles upstream of the Qaplan Kuh bridge on the Mianeh road.

The view of this comparatively low-lying region about 3000 feet above sea-level—so extensive and so hideous in its desolation—brought home to me vividly the wonderful fertilizing effect of the gaunt mountain ranges which form elsewhere so prominent a feature of Persian landscape, as, for instance, at Hamadan. The background of snowy mountains looks so barren and inhospitable, but they are a benign influence to the country and its inhabitants by feeding its springs, whence perennial streams pour down throughout the rainless summer months to irrigate the cornfields and gardens of the plain.

The Qizil Uzun valley above the Qaplan Kuh bridge also suggests the thought, with which I will close my paper, of Persia as a land of contrasts: the contrast between the barrenness of low-lying waterless regions and the fertility of the soil when irrigated by streams fed from the mountain ranges; the contrast of climate between lowlands and highlands, between the heat and drought of summer and the winter's cold; the astonishing contrast between the climate and landscape of the Persian plateau and of the Caspian provinces beyond the Elburz; and lastly, the contrast of races inhabiting these regions, between Persian and Turk, between the stalwart peasantry of the mountains and of the plateau and the more reserved and furtive Gilakis and Mazandaranis of the Caspian Provinces.

Before the paper the PRESIDENT (the EARL OF RONALDSHAY) said: The war gave a curious twist to the course of the lives of many of us, and our lecturer this evening is no exception to that rule. It was, indeed, the war which wafted him, quite unexpectedly, first of all to India, then to Mesopotamia, and finally to that land of curious physical contrasts, the northern frontiers of Persia. It is rather more than twenty years since I travelled up from Baghdad to Tehran, and, from what the lecturer tells me, I gather that there have been considerable developments, at any rate in the matter of road making, since those days. The old mule track, which used to meander up the mountain-side through the Zagros Gates on to the Persian plateau, appears to have been supplanted by a metalled road constructed, I understand, at great cost at the expense of the British tax-payer! But it is not so much of the tract of country between Baghdad and Tehran that we are to hear to-night as of those wonderful mountains which form the northern slopes of the Persian plateau and divide it from the Caspian Sea. That block of territory is far less known than the ordinary trade routes in Persia, and we look forward with great interest to the story which Captain Fortescue will have to tell us of his wanderings through that wooded or barren and mountainous country; and we look forward with equal pleasure to the pictures which he will show us of the remarkable scenery which that part of Asia provides. I have pleasure now in asking Captain Fortescue to give us his lecture.

Captain Fortescue then read the paper printed above, and a discussion followed.

The PRESIDENT: We are fortunate in having amongst us once more Sir Percy Cox, who for some thirty years past has played so great a part in the

history of the relations between Great Britain and Persia. I am sure you will welcome a few words from him on the subject of this evening's paper.

Sir PERCY COX: You have been kind enough to ask me, Mr. President, to make a few remarks on Captain Fortescue's lecture, but I really know very little personally about the particular tract of country that he was travelling in. His expedition was primarily the result of co-operation between the Officer Commanding at Kazvin and myself at a very favourable juncture when it seemed possible that we could send an officer over that piece of country which before the war was, and is again now, almost closed to British officers. Captain Fortescue was then Assistant Political Officer attached to Norperforce at Kazvin, but he was lent by the political authorities, with my advice and support, to the military side as being specially fitted to undertake this journey; and that gives us reason to appreciate the great use it is in one's early days to pursue one's sport or one's journeys in an efficient way. I think we have all appreciated the lucidity and excellence of Captain Fortescue's lecture and the many photographs that we have seen on the screen, both of the country and the types. I have only one regret as regards the expedition—that they were able to do very little in the direction of natural history. I would like to ask Captain Fortescue if he can give us any information as to what they met with in the way of mammalia, and in the main branches of natural history.

When I first went to Persia about twenty years ago one could travel almost anywhere with a walking-stick, but we do not quite realize, sitting here to-night, what considerable risks are run at the present time by such an expedition in that absolutely wild bit of country. Either whilst Captain Fortescue was away, or just before he went, another fearless young officer coming alone from Tabriz was ambushed and shot just off the map with which we have been dealing this evening. You never know what luck you may have. Almost at the same time an aeroplane on reconnaissance had a forced landing in that awful waste of hills which we saw in the last picture, but in this case the occupants of the 'plane happened to be very well treated. They made a very fortunate landing in a ravine, and they got away unhurt. Captain Fortescue is to be congratulated on coming through without any mishap and remaining on the best of terms with the Persians with whom he came in touch. In ordinary circumstances their best trait is their hospitality to strangers, but at times any little thing may occur to upset them, and when in out-of-the-way places one has to be very careful and tactful when dealing with them.

The present is not an occasion for talking politics, but Captain Fortescue mentioned the present Minister of War, Riza Khan. He appears to be a strong man. At any rate he has done an immense amount to bring the tribes into order and the country into some sort of order, a condition which it has lacked for years past. We can only hope he may last and make a permanent impression on the country. Placed as it is geographically with reference to us in India and our mandatory territory in 'Iraq, it is impossible that we can carry on indefinitely without a good understanding with Persia, and I trust we are coming back to that position under the guidance of the present Minister, Sir Percy Loraine. I am sure we all look forward to that, and it may possibly facilitate further expeditions of the kind of which we have heard this evening.

The PRESIDENT: We have another authority on the region present this evening who, I hope, may be able to add a few words, and that is General Dunsterville, who was in command of the British Forces at Baku at a very critical moment in the war in that part of the world.

General L. C. DUNSTERVILLE: I feel very much honoured by being called

A VILLAGE IN THE ELBURZ

SUMMER CAMP IN THE KARAJ VALLEY

THE QIZIL UZUN IN KHALKHAL

MIANEH

A TURKI VILLAGE IN KHALKHAL

QIZIL UZUN VALLEY ABOVE THE QAPLAN KUH

on to take part in the discussion on the interesting paper to which we have listened, but there is not very much that I can say from a purely geographical point of view. I was commanding the Military Expedition in 1918 which passed through the country that has been described, but obviously under circumstances which prevented me from taking as much interest as I should have liked in the geographical conditions! The only road that I was really well acquainted with was the one which the lecturer showed on the map from Manjil down to Enzeli, and that road is so well known that he did not dwell on it very much. What struck us all at that time was the extraordinary contrast which he has brought out so well in the lecture. I have never seen anything so barren as the whole of that plateau. You go through barren hills one after another with extraordinarily fertile valleys in between, and the moment you get over the Elburz you have, as it were, in one moment passed from barren land into almost impenetrable jungle. We had certain military information given us before we started down that road. I knew there were mountain passes on the hills to the east, but it is interesting to learn that there are no less than six between Kazvin and Tehran. We are never likely to operate on a large scale in that part of the world, or send big armies there, but still, as a soldier one is naturally interested in the military side of the problem, and the little detail we heard in connection with those roads was extremely interesting to me. I presume none of them are really practicable for anything except pack-mules, and they are a considerable height above the sea. But one could certainly get troops over them, and through them could turn that particular pass in which I was interested.

As regards the Shahsavan tribe, I had a good deal to do with them, though I did not meet them personally. They have the reputation of being ferocious bandits and robbers. So far as I was concerned it was the other way round; they loaded me with presents, or wished to; they were most anxious that I should deal with them on terms that we are not accustomed to. I was to supply them with Government arms, and in exchange they were to give me, privately, very large presents. They evidently have two sides to their characters!

Captain J. B. NOEL: In looking at the map shown by Captain Fortescue you may have been struck by the tremendous amount of country which he has covered in his travels in Persia: it is really awfully hard going. I had the good fortune to travel 800 miles with him, and he was a wonderful traveller. He can speak Persian absolutely like a native, and he used to make friends with every Persian that we met. A great pleasure on our journey was the cordial hospitality extended to us by the Persian people. Though we took camp equipment with us, we did not use a tent the whole time, and whenever we arrived in a village, the whole village used to turn out and give us the very best and most kindly hospitality. We were told before we started that we should have a very rough time, and we provided against difficulties by taking two soldiers with us; but they used their weapons only in trying to shoot ibex. There is wonderful shooting in Persia. Along the coast a sportsman could find an absolute paradise. Down in the forest near the sea he would have wonderful tiger-shooting, and very good duck. There are great lagoons all along the coast which are absolutely black with duck. In the spring he could go up to the highlands of the Elburz mountains and shoot ibex.

The PRESIDENT: Captain Noel has, I think, answered the question which Sir Percy Cox put to the lecturer with regard to the natural history of the country. But I thought Sir Percy Cox was a little unjust to our lecturer in saying that he had altogether neglected to tell us anything about it. There

was certainly one species of the insect, if not of the animal race, which he described in some detail, and he confirmed the impression which I remember that famous traveller in Persia many years ago arrived at—Lord Curzon—who said that the Persian bug was anything except a humbug! Those of you with any personal experience of Persia will have had brought vividly before your minds again the scenes with which you were once familiar. Captain Fortescue's narrative and photographs brought back to me many scenes of expeditions in Persia in years gone by, and I was particularly interested in the two photographs which he showed us of that extraordinary ceremony with which the Sh'iah Muhammadans crown the period of the Muharram—the tenth day of Muharram known as El Katl, or the day of murder, in which they mourn for the death of Husain. I witnessed in Tehran a dramatic representation of the murder of Husain, when I saw the whole streets of the city thronged with thousands of men in white robes, chanting their mournful liturgy and cutting themselves with knives. It is always pleasant to have brought back to one memories of happy journeys of one's own, and even those who cannot claim any personal acquaintance with Persia must have followed with the greatest interest the narrative of Captain Fortescue's travels, and have appreciated, above all, those excellent photographs, many so admirably coloured, I believe by the artist, the lecturer's father. I venture to convey to Captain Fortescue, on your behalf, your gratitude to him for the entertainment and the instruction which he has given us to-night.

FIELD-LONGITUDES BY WIRELESS

Captain P. K. Boulnois, M.C., Royal Engineers

Read at the Afternoon Meeting of the Society, 21 *January* 1924.

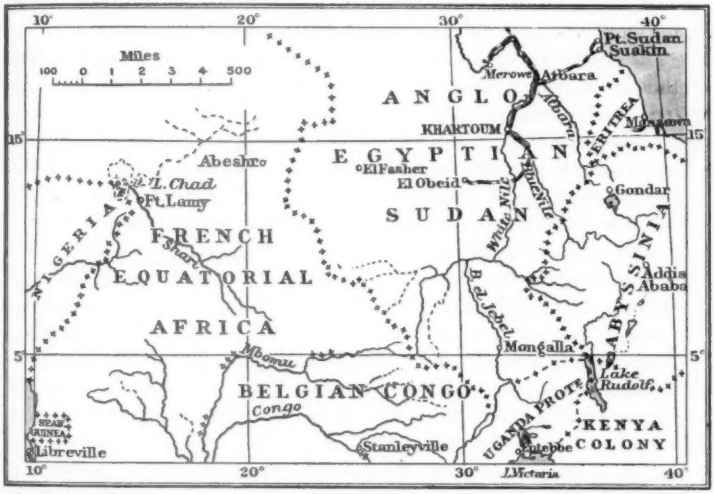
THE rapid improvement of wireless telegraphy in recent years has considerably increased the importance of using wireless time-signals as a means of determining differences of longitude in the field. The advantages of being able to obtain one's longitude to a considerable degree of accuracy anywhere in the field are obvious. Although much has been written on the precise determination of differences of longitude, there is a lack of information on the practical experiences of surveyors and explorers who have used the method during their work "in the wilds."

As several Field-Longitudes by wireless were obtained by the British parties of the Boundary Commission that has recently surveyed the frontier between the Anglo-Egyptian Sudan and French Equatorial Africa, some details of the practical experiences of those responsible for the survey on that very inaccessible frontier may be of interest.

Both the French and the British surveyors carried wireless receiving sets, and the French at one time had determined to rely entirely upon this absolute method of fixing longitude combined with astronomical latitudes to give the framework upon which to hang the topography along the whole length of the 1200-mile boundary. This plan was

however modified, and triangulation used by both missions for the greater part of the work.

The initial points of the triangulation chains were fixed by astronomical observations combined with wireless time signals. During the 1921–22 season no serious obstacles to successful triangulation were encountered, but in the subsequent winter matters were very different, owing to the nature of the terrain along the Nile–Congo watershed which forms the agreed frontier of the Sudan from Uganda to about the 11th parallel of northern latitude. The part of that watershed which we were called upon to find and to survey was from the point of the junction of the Belgian Congo, French Equatorial Africa, and the Sudan, to a point



Sketch-map of the boundary between the Anglo-Egyptian Sudan and French Equatorial Africa.

about latitude 9° 15′ N., longitude 24° 40′ E., where our work had to join up with a chain of triangulation brought down from the north.

Along 75 per cent. of this stretch of the watershed it would be no exaggeration to say that one's average limit of vision is 20 yards or so. The forest is particularly dense, though not high, along all that part of the divide, and, what is more important to the surveyor, there is a singular lack of high ground or of isolated points rising above the surrounding forest. Along this 300 miles of boundary triangulation had to be abandoned, and geographical coordinates obtained by astronomical observations and by wireless field-longitudes.

Apart from the virtual impossibility of carrying out triangulation in anything like reasonable time in such flat forest country, there is this point to be remembered in Boundary Survey which adds to the value of control points fixed by wireless time signals. A triangulation has neces-

sarily to cover ground which is suitable to itself; high points, mutual visibility, and well-conditioned triangles all influence the selection of trig. points, and these may well find themselves in positions which are of little or no value to the topographers. A chain of triangulation is comparatively useless for mapping the detail when from the intervening ground no three points in it are at one and the same time visible for resection; or if the chain, owing to the lie of the ground, has had to be carried at any great distance away from the strip of territory that it is required to survey. When the method of filling in detail has perforce to be that of traverses, there is no doubt that it is of very great advantage to be able to place the control points exactly where they will be most useful to the traverse work. Such a possibility is best realized by "absolute" methods of obtaining geographical coordinates.

The conditions of the Nile–Congo watershed survey were as I have outlined. A triangulation might have been just possible, but the chain of trig. points would have had to be at some considerable distance from the boundary itself. Plane-table work would have been impracticable over a very large proportion of the stretch involved. Traversing with compass and perambulator was employed throughout, and to adjust the traverses we established eight longitude stations selected approximately 40 miles apart upon the actual watershed. We fixed the longitude of these points by the reception of time-signals from one or other of the following European wireless transmitting stations: Bordeaux (Lafayette), Lyons, Paris (Eiffel Tower), or Berlin (Nauen).

Our wireless receiving set was designed by the Signals Experimental Establishment of Woolwich, and was in every way excellent. I am not a wireless expert, and therefore it is useless for me to speak of the design of the set except on one or two practical points.

Apart from carts and motors, the forms of transport available in Africa are either camels, donkeys, or porters. A wireless receiving set (just as any other part of one's equipment) should therefore be capable of divisibility into loads suitable for any of these: 45–50 lbs. suggests itself as the best unit to aim at. One package would then be right for a porter, two for a donkey, and four to six for a camel.

For working the valves we had accumulators at the start of our work, and these proved difficult to maintain in a state of efficiency when the means of transport were, to say the least of it, rough. The alternative to carrying accumulators is to arrange for a supply of dry batteries at regular intervals. There is a form of dry battery called the Inert type which is most suitable. Siemens and other firms supply them. Personally I would rather arrange such a supply than again face the difficulties of transporting accumulators.

Our receiving set was provided with both valves and crystal, but no use was ever made of the latter, and our time-signal work was all done with five valves. The set was designed originally for the reception

of signals up to about 3000 metres wave length only, as it was thought that the Eiffel Tower signals would be our mainstay. As Nauen sends on a 3,100 metre wave length we were able to hear that most useful station as well as Paris, but the limitations of wave length precluded the use of Lyons and Bordeaux until at the end of 1922 a special coil attachment was sent out to us, enabling the set to pick up the higher wave lengths upon which the signals from those two stations are transmitted.

To avoid having to carry additional coils it is as well for a surveyor to specify which stations he intends to work with when obtaining his receiving set, but to do this he must have some fore-knowledge of the atmospheric conditions as they affect wireless of the region in which his work will lie.

In Africa, as in every other tropical country, the greatest trial in wireless longitude work is the prevalence of "atmospherics." These annoying disturbances, which at times drown all other sounds in the receiving telephones, are the factors which largely make or mar the success of the determinations. Our experience on the Nile–Congo divide was that on about 50 per cent. of nights atmospherics would be so bad as to prevent our booking the signals from Paris or Nauen. During the day neither of those stations was even audible. Daylight is well known to be prejudicial to the strength of wireless signals, but our own experience did not confirm an opinion expressed by a geographical writer that "moonlight has the same damping effect on the electromagnetic waves as has the sun, only to a less degree."

Atmospherics were always most pronounced when there were thunderstorms in the neighbourhood. The wetness or dryness of the atmosphere did not seem to have an appreciable effect one way or the other. The signals transmitted from either Bordeaux or Lyons were never drowned by atmospherics, and these stations could be heard clearly even during daylight.

The aerials supplied with our receiving set were of both the "frame" and "line" type. At our first test we tried the frame aerial and then the line, and found we got a stronger signal with the latter. Lack of time was our worst enemy during the boundary survey; we therefore could not continue to experiment with the two types of aerials, and for the remainder of our work we used the line aerial only. This was 300 metres long and was carried on 15-foot tubular iron masts, each in three sections. To set up the aerial and the masts in the forest demanded a great deal of clearing, but we always had plenty of labour available for this purpose. Stretching out to the front of the main aerial were several ground wires each about 50 metres long carried on wooden pegs at a height of a foot or so from the ground. These ground antennæ were probably essential, but their presence was a nuisance, for they seemed to exercise a curious attraction on straying donkeys, and the natives were constantly tripping up over them. In order to obtain

satisfactory results we found it very important that the aerial line should be set up as far as possible in the plane of the Great Circle which passed through the transmitting station and our own position in the field. To obtain the alignment a compass bearing is enough; but an error of as little as five degrees in the setting is likely to prejudice the satisfactory reception of the time signals when, as in the case of our work, the power of the transmissions was only just sufficient to reach our reception set. On one occasion we were much troubled by the non-reception of Nauen signals on an apparently first-class night, until we discovered that the alignment of our aerial was 10 degrees in error owing to careless reading of the compass in setting. On putting this right the Nauen signals, and those from the Eiffel Tower, were faintly audible.

As far as was possible we would select a site for our aerial that was a little higher than the surrounding ground. Where it was not so we found that clearing away the trees and bush immediately in front of the aerial, that is to say between the set and the distant transmitting station, would considerably improve the power of reception.

Owing to the amount of tree felling and general clearing involved in these operations, undoubtedly a frame aerial would be the more suitable type for a surveyor or explorer who had not a large labour force at his disposal. It was a great pity, therefore, that lack of time prevented us from carrying out any further experiments with the frame.

The third annual report of the B.I.H., on the work done in 1922, gives the following list of sime signals in operation during that year:

No.	*Time.*	*Transmitting Station.*	*Type of Signal.*	*Nature of Transmission.*
1	08.00	Lyons (YN)	Rhythmic	15,500 C.W.
2	09.00	,,	Semi-automatic	,,
3	09.30	Eiffel Tower (FL)	Automatic	2,600 spark.
4	10.00	,,	Rhythmic	,,
5	10.45	,,	Semi-automatic	,,
6	20.00	Bordeaux (LY)	Rhythmic	23,400 C. W.
7	22.00	Eiffel Tower (FL)	,,	2,600 spark.
8	22.45	,,	Semi-automatic	,,

Considering that there was always a risk of being unable to hear the time signals from the Eiffel Tower and from Nauen even at night, it was disappointing that after the addition of coils to give the high wavelength range we were not able to confine ourselves to the B.I.H. time services from the powerful stations of Bordeaux and Lyons only.

Unfortunately, owing to our information not being up to date, we were not certain at what hour the times for the first and last beats of the Bordeaux rhythmic signals would be sent. Under normal circumstances one might have tried once or twice and have eventually picked up the all-important groups of figures in spite of not knowing exactly when they were to be expected. Unfortunately, our accumulators were

then derelict, and we were relying entirely on an emergency set of dry batteries to supply us with the necessary power to light the five valves of our receiving set. With little or no hope of getting batteries replaced before the end of the work, we were compelled to economize every minute of having the set in use.

But for this unnecessary doubt as to when to " stand by " for the figures we should doubtless have used the rhythmic signals from Lafayette (Bordeaux) to the exclusion of all other of the B.I.H. services. The signals from Lafayette were so clear both by day and by night that there would be no question of being able to read groups of figures sent by that station in those regions of Africa where our work lay. But this was not the case with the Eiffel Tower signals, and therefore the rhythmic signals from Paris were never used, for we should rarely have been able to pick up the figures for the first and last signal.

Lyons sends out time signals only in the morning. This is a disadvantage in field work, for to obtain a comparison with the chronometer during the day one would have to remain at the station to " rate " the chronometer. With signals at night " rate " hardly comes in, for one can observe stars for local mean or sidereal time immediately before and immediately after the reception of the wireless time signals. This close " straddle " of the time signals is most important under field conditions, for it is not likely that after much travelling the surveyor's chronometer or possibly half-chronometer will have a particularly constant rate, nor can one usually spare the time to let the chronometer settle down from its travelling to resting rate.

Another reason that led us to use automatic signals, and not the rhythmic transmission from Lyons, was that we had no apparatus for bringing the tick of our chronometer into the telephones. To judge a coincidence by ear and eye is much less accurate than judging by ear alone, and experiments with the rhythmic beats led us to the opinion that to be really truthful one could not say on which of about six to eight seconds the coincidence with a dot took place. If the second beats of a clock or chronometer are brought into one ear-piece of the telephones in which rhythmic time signals are also being received, there is no doubt that one can judge coincidence very accurately, but even then there may be reasonable doubt as to one of three or four beats. It is hardly possible to carry anything but an ordinary chronometer or half-chronometer in the field, and to obtain a tick in a pair of telephones from such an instrument is best done by fitting up a circuit from a microphone cemented to the chronometer face. A chronometer tick is never particularly sharp, and the microphone seems to accentuate this " wooliness," as I must call it for want of a more scientific word.

There is one small criticism about the rhythmic or scientific time signals that I have to offer, and that concerns the groups of figures giving the time of the first and last signal of which mention has already

been made. Unless those groups are picked up on the receiving set absolutely correctly, the whole of the previous time reception is rendered null and void. This may seem a trifling difficulty to those who have used wireless extensively, but it is a source of worry if nothing else to a hard-pressed surveyor endeavouring to pick up distant stations under varying conditions of atmospheric disturbance and with receiving instruments which cannot ever be properly cared for. At eight o'clock in the morning one may hear the whole series of Lyons signals, and at half-past eight for some small fault there may be not a sound to be heard.

Rhythmic signals have another disadvantage in the field. To book the rhythmic dots and also to record the chronometer seconds on which coincidence takes place, two observers are necessary. The one who merely ticks off the rhythmic dots and makes a longer stroke when the observer who is judging coincidence taps on the table or touches him with his hand need not be highly intelligent, but he must be more so than a native workman or follower. Assuming that the surveyor is also his own wireless operator, and has not, like our Boundary Commission, a trained non-commissioned officer to help him, he will be unable to book rhythmic signals and chronometer readings by himself.

The various considerations that have now been touched upon will, I hope, make it clear why for field-longitude work the older types of wireless time-signals, in which time dots are sent out at exact instants of Greenwich mean time, still retain their value. Looking through the 1921 'Corrections des signaux horaires,' issued by the B.I.H., we find that the greatest correction that has to be applied for the month of December 1921 to the 22.45 semi-automatic Eiffel Tower service is four-hundredths of a mean-time second. This shows how accurately the signals are now being sent, and the corrections are always available to the surveyor on his return, or if within touch of posts they can be applied whilst he is still in the field.

A dot on an exact instant can be booked in the field with just as much accuracy as can the passage of a star over a cross wire; and when, as in all automatic or international type signals, there are thirteen separate instants bookable in one series, the mean of the booked times should attain an accuracy very near that to be expected when using rhythmic signals and the "time vernier." The semi-automatic type of time signal offers only three possible bookings in one series, and does not possess therefore the value of the international type to the surveyor in the field. There is another disadvantage belonging to the older type of three time-dots that is not perhaps so well known. Preliminary signals, sent by hand, continue until five seconds approximately before the automatic sending of the dots on actual "time." Listening to this, one experiences an unpleasantly long wait during which atmospheric and outside disturbances are liable to distract the attention, and one is, so to speak, "caught" by the final dot that is so all important. With the

international type of signal there is a delightful rhythm, and the fact that every component of the signal is sent by automatic apparatus on definite instants of time gives one a large number of variants with which to compare one's chronometer. Thus one can choose the dots alone, or the ends of dashes, or the beginnings of dashes in the signal, and missing one or two of the component dashes or dots is not so serious as missing one of the time-dots in the semi-automatic type. The latter type of signal has, however, a very definite use in the field, as a preliminary to obtaining good bookings of international signals.

At the end of say three days' traversing with compass and perambulator one will only have a very rough idea of longitude. The night may prove clear, and yet there is no saying whether atmospherics will be bad or not; and nothing is more annoying than to take a series of observations for local time and then find that the wireless time signals that you had hoped to pick up are inaudible or too indistinct to book accurately. The importance of " straddling " the wireless signals by time observations has already been emphasized. If one can take in a semi-automatic signal of three time dots prior to receiving more valuable signals, the above-mentioned difficulties disappear. No matter what vagaries the chronometer may have adopted during the traverse march to the longitude point, the reception of the single time signal will tell you within half a second when to stand by for the subsequent automatic signals, and these can then be prepared for and booked from their beginning to their end. If the first series is heard clearly it is an indication that the conditions are favourable for wireless, and the surveyor can turn to his theodolite or portable transit, and with confidence start his time-star programme.

For the determination of the longitude of six out of the eight stations on the Nile–Congo watershed in the early months of 1923 we made use of just such a method as I have outlined above. About a quarter-past to half-past eleven at night, according to our approximate eastern longitude, we would listen for the 22.45 hours Paris semi-automatic signals and so get to know when to expect the automatic signal from Nauen between 23.58 and midnight. If the Eiffel Tower was clear, we would immediately after its reception take two east and two west stars for time, and then be ready to book the ends of the dashes which mark 23.58, 23.59, and 24.00 hours G.M.T. and the dots which begin at 23.58, 10, 20, 30, 40, and 50 and at similar seconds for $23^h\ 59^m$. With two Europeans booking these we got, I think, very accurate results. Four stars would be similarly observed for time immediately after the reception of the Nauen signals.

Unfortunately, there was only one point whose longitude was separately determined by the two quite independent survey parties, but a comparison of the values obtained may be of interest. One value depended on triangulation from an initial point fixed by latitude and wire-

less longitude, so there is the possible error of the triangulation also to be taken into account.

	Latitude N.	*Longitude E.*
Value as obtained by triangulation	08° 27′ 20″	24° 41′ 27″
Value obtained by independent observations ...	08° 27′ 19″	24° 41′ 30″

Our instruments for astronomical observation were only 5-inch theodolites. Even with field methods of booking and under difficult conditions of hearing, I was impressed by the superior accuracy attainable in the reception of the wireless signals as compared with the results for local time that were usual with 5-inch instruments; and my own feeling is that such instruments are not accurate enough even for field work with wireless. Whether the surveyor should carry a theodolite, portable transit, or astrolabe is a matter of opinion. According to one writer a precision of about 0·05 second of time is attainable with a small prismatic astrolabe, weighing some 35 lbs. only, in stellar time observations, and the same writer quotes 0·03 as the P.E. for the "geodetic" type of astrolabe of about 70 lbs. weight. Whichever instrument is preferred, it should be borne in mind that generally the actual determination of time is less accurate than the wireless time signals received and booked; and I strongly recommend any one who wishes to use wireless for field-longitudes to consider the advisability of taking with him some instrument of the order of a 10-inch theodolite.

As regards the question of automatic booking of time signals, some very interesting experiments in chronographic recording of wireless time signals have been carried out, but it is hardly within the scope of this paper to discuss such automatic methods of booking. With a chronographic record of rhythmic signals it is easy to determine which of the marks are caused by "atmospherics" and which by the signals themselves, owing to the regular spacing of the latter.

Personally, I should seriously consider taking a chronograph into the field if high accuracy was desirable: not only for recording the wireless signals, but especially to record the passage of stars over the wires in the observations for time. But to make the tiny currents that are sufficient to produce a tick in the head phones of the receiving set actuate the pen of a chronograph demands considerable amplification and therefore additional instruments.

My own suggestion to improve accuracy of reception is to make the clock or chronometer do the mechanical part, and leave the wireless signals severely alone. Thus, if one had a clock which at every second will close a circuit, and if the wireless signals in order to reach the telephones are made to pass through that circuit, there will be no sound in that pair of telephones except when a signal coincides with a second. Another telephone circuit would receive the rhythmic signals in the ordinary way for counting. With such an arrangement one would obtain the fullest value of the rhythmic time signal services.

I have only one suggestion to offer as regards the improvement of time signal transmissions. Having struggled in Africa with weak signals from the Eiffel Tower, I think that, for work in that continent at any rate, Bordeaux might be used to send out every type of signal.

The ideal for a surveyor there would be to have a semi-automatic transmission from that powerful station at, say, 21.00 hours. The three time-dots received then would give him an accurate knowledge of when to expect the subsequent signals. At 22.00 hours, after he has had an hour to take astronomical observations, a series of rhythmic beats followed by an automatic mean time transmission might be given, and at 23.00 hours the groups of figures for the sidereal time of the first and last of those rhythmic signals could be sent. When fixing an important point such as the initial point of a triangulation, the surveyor would use the rhythmic signals, but at a point where the order of accuracy attained by such signals is not necessary, such as at a control point in a traverse chain, he would probably be satisfied with the automatic mean-time type. At any rate, with Bordeaux sending he would feel pretty confident of successful reception.

TECHNICAL APPENDIX ON FIELD EQUIPMENT FOR WIRELESS LONGITUDES

Major C. J. Aston, Signals Experimental Establishment, Woolwich.

1. As the wireless equipment used by Captain Boulnois was designed and made by the Army Signals Experimental Establishment, that Establishment has been honoured by an invitation to deal with some technical points that may be of interest to surveyors. An attempt has been made to collect as much reliable information as possible in a small space, whilst avoiding matters which may be the subject of controversy. Owing to the widespread interest that has recently been shown in the subject of wireless, an elementary knowledge of the general principles involved is assumed.

2. Owing to the very varied climatic and topographical conditions in which surveyors may be called upon to work, and the world-wide distribution of areas that may have to be surveyed, it is not possible to standardize a suitable wireless equipment. Each case must be treated separately, and apparatus must be designed to suit particular circumstances, such as: (*a*) The power, wavelength, type and distance of the station whose signals it is desired to receive. (*b*) The climate, temperature, and the nature of the country to be surveyed, *i.e.* whether desert or mountainous. (*c*) The distance from the base, and the kind of transport involved.

Generally speaking, the equipment must be robust and foolproof, as probably there will be no specialists with the party.

3. It is accordingly necessary to give ample notice, say six months if possible, to enable the wireless engineers to design, test, construct, and try the equipment. During the latter part (say two months) of this time, one or more men should be attached to the Design Establishment in order to study the principles underlying the design, to learn the use of and obtain instruction in the adjustment of and minor repairs to the apparatus. It is imperative that at least one of the party should have a fair knowledge of the principles

and practice of W.T., and that one man should be made responsible for the efficiency and use of the gear. Needless to say, an understudy is most desirable as a re serve.

4. There are two main systems of wireless employed for time signals, "Spark" and "Continuous Wave," both producing æther waves which are propagated with the speed of light along great circles from the transmitter. "Spark" consists of trains of waves, each spark comprising a short train, the sparks or trains arriving at a frequency audible to the ear, say 1000 per second: whilst each train comprises a number of waves arriving at "radio frequency," say 100,000 complete waves per second which are inaudible. A signal consists of a series of sparks repeated during the period of the signal. "Continuous wave" consists of one uninterrupted wave-train at radio-frequency which persists for the whole period of the signal. This wave train cannot be made audible unless interrupted at the receiving end.

5. These waves cause electric forces of equivalent frequency in the aerial. The function of a wireless receiving set is firstly to sort out and isolate the forces produced by the correct transmitting station, from the forces produced by other stations and by atmospherics—this is called "tuning"; secondly, to render these forces audible—this is called "detecting"; thirdly, to increase the strength of the forces and so render the sounds louder—this is called "amplifying." Amplification may be applied either before detecting, called H.F. Amplification, or after detecting, called audio-frequency, low frequency, or note amplification.

6. Tuning is carried out by variable condensers and inductance coils, which are designed to suit the wave-lengths required. The simplicity of a tuner depends on the proportion between the minimum and maximum wave-lengths it is desired to receive. Thus a tuner for all wave-lengths between 12,000 and 24,000 metres (ratio 1 to 2) will be much simpler than one covering 2400 to 24,000 (ratio 1 to 10). This fact is of the utmost importance in selecting the time-signal stations used by a survey party, as simplicity is an essential factor.

Detecting may be effected either by a crystal or a valve, and the resulting electric currents are led into a telephone receiver or recording device. Spark signals can be detected by either crystal or valve, as they are of audible frequency.

Continuous wave signals must be broken up into audible frequency before detection, and by far the best way of accomplishing this is by the method known as "Beat" or "Heterodyne Reception" which requires a valve to generate weak local currents which beat at audible frequency with the currents produced in the tuner by the waves arriving on the aerial.

The broken up continuous wave can now be detected by a crystal or valve. A valve is usually employed in the heterodyne, a crystal being seldom used, as it has several disadvantages. No further reference will be made to crystals.

Amplification necessitates the use of valves and means of coupling them in sequence. This system forms the Amplifier. The design of the Amplifier depends very much on the strength of the forces produced in the aerial. Its ultimate object is to make the signals strong enough to be heard or to work a recorder. The smaller the aerial the more amplification is required. An average figure may be taken as five magnifications per valve, so that a 3-valve amplifier would magnify 125 times; 5 valves, 3125 times, etc.

A small frame aerial produces only very small forces and requires on an average two valves more than an open aerial does, and this means more battery power.

7. Aerials can assume an almost infinite variety of forms; the surveyor is concerned only with the simplest. Their size depends on the wave-length to be received: the longer the wave the larger the aerial, particularly at great distances from the transmitting station.

The following forms will be mentioned: (i) A single raised wire suspended from a high tree, building, or the like, or supported on short masts (12 to 30 feet high). (ii) A single insulated wire laid on the ground. (iii) A small frame rotatably mounted on a vertical axis and wound with a number of turns of wire.

(i) Bearing in mind the fact that a surveyor may find himself in districts where there are no trees convenient, it is probably essential for him to carry some form of mast, especially as a long wire is more suited than a short one for the long wave-lengths on which time signals are transmitted, and long wires require some means of support. Trees blow about in the wind and may break the wire. A long, fairly low, horizontal wire is less liable to atmospherics than one suspended at a height. The problem is much akin to that of portable Army Wireless Sets. Military aerial equipment has been carefully developed to suit diverse transport conditions, and will be found suitable for survey parties.

A single wire aerial 200 to 400 yards long on portable 15-feet masts is the type recommended for general work on wireless longitudes. If it is not convenient to use this length, a trial may be made with one end supported on a high tree.

(ii) A single insulated wire laid on the ground is extremely convenient in many ways; it is quite good in dry climates, and is more free from X's ("atmospherics") than raised aerials. It has the disadvantage that moist soil and wet weather may cause extremely variable effects; also damage to the insulation, due to people or animals treading on it, may easily spoil its efficiency to the extent of rendering it useless. On absolutely dry sand, such as is met with in desert surveys, such an aerial is as efficient as a raised one, and since dry sand is an insulator, a bare wire may be used in an emergency. For general use by personnel who are not specialists in wireless, this type of aerial is recommended only for desert surveys, but it may be found useful elsewhere.

Both types (i) and (ii) should be aligned within 5° of the great circle through the transmission and reception stations, and the reception set placed at the end nearest the transmitter.

(iii) Small frame aerials are usually about 3 to 4 feet square. They are not suited to rough transport conditions. For long-wave work a large number of turns of wire (eighty or more) must be used, which renders repair difficult in the field. They have the advantage that they are practically non-receptive in a plane at right angles to their own, and this property may be very valuable in certain localities when they can be turned so that this non-receptive plane coincides with that of jamming or atmospherics. They require multi-valve amplifiers, as the forces produced in them by wireless waves are very weak.

Attempts are at present being made to develop a portable frame for Army use, but there are many difficulties: if the problem is satisfactorily solved, and a frame suitable for pack-transport is evolved, it may prove to be of value to surveyors; this development, however, is for much shorter wave-lengths than are used for time signals, which simplifies the problem for the Army.

8. Valves require electric batteries as accessories for two purposes—heating the filament, and as a source of potential or high tension for the anode circuit. Usually a number of valves are arranged to use one common filament battery and one common anode battery.

These batteries represent a serious problem in isolated localities. Accumu-

lators are used, whenever possible, for the filament battery, as the current is usually too high for primary batteries to supply continuously. Primary batteries are generally used for the anode. Both types have disadvantages.

Accumulators are apt to be messy and troublesome, and necessitate a charging plant, which is a complication. The lead type is best as it can be made almost, if not quite, non-spillable, but it contains acid and will not stand very rough handling.

The Edison type is very robust and foolproof, but no satisfactory non-spillable type has, so far as the writer knows, been evolved.

Probably, for surveyors the best solution is to use a primary filament battery in conjunction with " dull emitter " valves (which require a very small filament current), and then only to burn the valves for a minimum time per day.

Primary batteries are made up in a portable form known as " dry cells," which are really damp inside and sealed up. These however rapidly deteriorate in store, especially in hot climates. A special type known as " inert " or " desiccated " is particularly adapted for such climates. It is rendered active when required by the addition of water, and it then is nearly as good as a new dry cell. Before water is added, it will keep almost indefinitely, especially if made up in airtight packets.

In very cold climates dry cells may be relied upon, as they do not deteriorate if kept, from date of manufacture, at a temperature of 20° F. or less, and very little below 40° F. When in use, however, they must be kept above 32° F., or they may not work well enough to act as a filament battery.

In any case it may be sometimes necessary for a fresh supply of batteries, of whatever kind, to be brought from the base. If dry or inert cells are used they may be damaged and will be exhausted, and the reserve at the base will have to be drawn upon. If accumulators are used the charging set will probably not be able to accompany the survey party, and will be left at the base ; in that case frequent transport to and from the base will be necessary. It is almost certain that accumulators will fail under coolie transport conditions.

9. The following notes are intended to summarize some of the principal facts governing reception of W.T. signals and to indicate possible causes of failure.

The range at which signals can be read is a very variable factor. It does not depend merely on the strength of the signals received, but is governed by the " signal ratio," *i.e.* strength of signals received to strength of interference by atmospherics and jamming by other W.T. stations.

The strength of signals received from a given constant transmitter varies as follows :

(i) With distance ; the variation is not a simple ratio, and the transmitting stations should be chosen so as to cover the entire area to be surveyed without approaching their extreme ranges.

(ii) With atmospheric conditions. Sometimes a kind of wireless fog exists which may render signals nearly or entirely inaudible, especially in hot thundery weather. Sometimes reception is exceptionally good. Conditions are always variable during the period when sunset or sunrise is taking place between the transmitting and receiving stations ; when the whole distance between sender and receiver is in darkness, signals are generally better than they are in daylight. These facts should not be forgotten when choosing the station to be received, as the hours of one possible station may be less suitable than those of another.

(iii) With the height of the receiving aerial, and its direction when its length is more than about four times its height. The higher the aerial the stronger

the signals, but also the stronger the interference. Increasing the height may not improve the signal ratio and may decrease it. The best height is a matter for trial or experience. Between 12 feet and 30 feet will generally be found suitable. The best direction is when the aerial points from the instruments in a direction away from the transmitter. The accuracy necessary in direction increases with the ratio length/height.

(iv) With the nature of the site and the surrounding country, High land is better than low. Wet is better than dry. Flat is better than mountainous. Open is better than wooded. A site in a deep valley crossing the direction of arriving signals or a site close behind dense woods is bad; the lower parts of the wireless waves may be deflected or absorbed and give poor results, whereas further on they may become re-established and give much better results. The longer the wave-length the less is this screening noticeable.

(v) With the nature of the earth connection. Water or wet ground is a good conductor, and direct contact should be made by earth net, metal stake, etc. On rocky or dry sandy soil direct contacts cannot be used owing to great electrical resistance. In such sites a well-insulated counterpoise is the best, say eight wires 30 yards long, radially arranged and absolutely insulated from earth. This system acts as one plate of a condenser, the other being the conducting soil under the sand, etc. A badly insulated counterpoise is worse than a bad direct contact earth, as it possesses neither the conductive nor the condenser property. If rubber-covered wires are used as a counterpoise they may be laid on the ground; but they are then liable to have their insulation damaged. Moreover, rubber-insulated wires are heavy to carry, and generally bare wires suspended and insulated above the ground are best, though inconvenient.

The strength of atmospherics (or X's) is rather a feature of the locality than of the reception apparatus. Little is at present known as to their origin or nature. Some arrive vertically downwards and some horizontally from a distance. Both types excite the aerial and receiving circuits by shock, in a way similar to that in which a pistol-shot will excite the wires of a piano, causing electrical oscillations at the frequency to which the circuits are tuned. Atmospherics cannot be eliminated, though their effects can to a limited extent be minimized.

Directive aerials are more immune than non-directive ones, from horizontally arriving X's. X's may arrive from different directions at different times of the day. In some localities a general rule may be found, and in such places the use of a small frame aerial has the advantage that it may be turned to the direction best suited to minimize the effect of these X's arriving from a known direction.

The cause of X's is probably connected with the electrification of the upper layers of air, clouds, etc., by the ionizing property of strong sunlight. Lightning always produces X's, which may travel very long distances.

The strength of jamming by other wireless stations cannot be predicted. It depends largely on the nature, power, and distance of the station. Spark stations are much more troublesome than C.W. in this respect, though some C.W. arc stations are bad offenders as they radiate harmonics; but these are not troublesome on long wave-lengths or at long distances from the transmitter. Jamming cannot always be avoided or much reduced. Heterodyne reception of C.W. signals is probably the system least liable to jamming.

Before the papers the PRESIDENT (the EARL OF RONALDSHAY) said: This

afternoon we are to have an account by Captain Boulnois of the use of wireless telegraphy in survey work. Captain Boulnois was engaged upon the boundary between British and French territory in the Sudan, and in connection with that Boundary Commission one naturally recalls, with profound regret, the death of the chief of the British Commission, Colonel Pearson, from blackwater fever while actually engaged upon his task. The officer who took his place, Mr. Boyce, is no longer in this country, having been recalled to the Sudan as soon as the discussions in London in connection with the boundary were concluded. But we are fortunate enough to have secured the presence of the other member of the Boundary Commission, Captain Boulnois, and he will be able to give us first-hand information as to the value of wireless telegraphy in this particular sphere of work. I have much pleasure, therefore, in calling upon Captain Boulnois to give us his paper.

Captain Boulnois and Major Aston then read the papers printed above, and a discussion followed.

Captain C. T. HUGHES (Royal Corps of Signals): Major Aston has covered the subject on the technical side, but I feel that Captain Boulnois' paper has brought out a number of important points to designers who may be engaged on these sets. The first seems to me to be the importance of suiting the load to the country, and that emphasizes the fact that the surveying party ought to get in touch with the designer as far ahead as possible. In this particular case time was short, and the loads had to be made up in some standard pack panniers originally designed for good stout mules or army horses. That is the reason for the 70–80-lb. load. It is obvious that that particular load is wrong for that country, but, as I said, time was pressing and the gear had to be packed into those particular panniers. Also one must know the nature of the country. In this particular case a set which started out to do one job and which was designed for desert work, eventually found itself in bush country. If we had known that the set would eventually have got into close bush we would never have sent out that long aerial with the multitude of counterpoise wires. I want to point out that when this set was first asked for there was very little information available as to the most suitable type of set to supply. We had reports of survey work in Hejaz and in Palestine, and a certain amount of survey work had been done during the war in Egypt, and we also had some accounts of Dr. Hamilton Rice's Central American work. Running through those reports one definite line was brought out: that for desert wotk the long low aerial with that extraordinary complication of counterpoise wires was undoubtedly the best that could be used. We had not much time to tackle the question of small frames. As a matter of fact, it so happened that at the time we were asked to provide this set we had been experimenting in connection with the reception of time signals from Annapolis, using a small frame about 4 or 5 feet square, and we were none too happy about it. We found it required something like six or seven valves. It was a somewhat complicated set and rather heavy on accumulator batteries. Even with this arrangement the signals were none too good, and we could not be certain even in these latitudes of picking up Annapolis on the small frame. The distance from Annapolis to London is comparable with the distance from the Sudan to London or Berlin. Therefore it was felt better to play for safety and send out the long aerial. The paper has made it clear that that system of counterpoise wires stuck up above the ground a few feet or so is impracticable if a party travels with a number of animals or camp followers. It always has been a

great difficulty in using this sort of thing. It is however extraordinarily efficient. But, as a matter of fact, I believe if we had to do the work again we should, as Major Aston suggests, use a counterpoise consisting of rubber-covered wires actually laid upon the surface of the ground.

Major Aston has touched on these as an alternative to using an elevated aerial on masts. There is a great deal to be learnt yet about the use of these ground wires; results so far have been somewhat contradictory. We have had extraordinarily useful results in the case of rubber-covered wire laid out on the sand in places such as Northern Egypt. There it was found that that system resulted in a very great decrease in the atmospheric interference, which is an all-important factor in the design of receiving sets for tropical work. The frame aerial also still needs a good deal of experimental work before one can decide as to what is really the best type to make up for pack transport. Major Aston has emphasized the difficulty of producing a really useful type of set that can be packed up in a compact space and put on a donkey or made into porter-loads, to be unpacked and used several times over without developing faults; but I have no doubt there is a solution to be found to that difficulty. It is a matter for experiment.

There is one point, perhaps, which ought not to go uncorrected in Captain Boulnois' paper. He suggests that a surveyor working in very close bush country might find a small frame aerial to be the most useful type. I want to point out that a frame aerial is very subject to screening due to the dense bush and trees; in fact, it appears to be more subject to screening than the ground wire or a long elevated aerial. It is very difficult to predict just how much a frame aerial in bush country will suffer. We know that Dr. Hamilton Rice used a frame aerial with great success in what I believe was very dense jungle country, but unfortunately these conditions as regards screening do not appear to hold from one part of the Earth to another. It simply comes to this: that one will have to examine the circumstances affecting the particular survey party before one can decide whether the frame or an elevated aerial or the ground wire should be adopted.

Captain Boulnois has, I think, pretty well killed the accumulator for this class of work, unless future parties prove to be better off in the matter of charging arrangements. It is a point of tremendous importance to us as designers to know that the set sent out worked with inert or dry cells. The whole thing was rather a gamble because, so far as I know, no set had previously been sent out to work under those conditions, at a great distance from the base and having to rely on dry cells, even as a stand-by.

The set sent out to Captain Boulnois was one of the first to go out fitted with what are known as the dull emitter type of valves, which have only recently been put on the market. They seemed to offer a very easy way out of the difficulty of keeping the receiving gear going where accumulators are so very difficult to obtain. As a matter of fact, it was not easy to choose which valve to send. We had at that time two types: one a valve very economical on batteries but extraordinarily fragile. The little glass bulbs had to be mounted in a large mass of sponge rubber in an outer containing case, and every time the operator sneezed the filaments went out! The other type of valve was heavier on batteries but seemed fairly robust. Eventually the latter type was chosen. It is a matter of considerable relief to me to realize that the valves actually did work with inert cells, because it means that a survey party can in future be independent of accumulators with the almost inevitable charging set, petrol engine, switchboard, and all the accessories that are such an awful nuisance.

Accumulators are undoubtedly a source of considerable trouble in the field where they cannot have a fair amount of supervision and skilled attention. There is one way out of this difficulty, perhaps, which would repay a certain amount of experimental work, and that is to develop a hand-driven or pedal-driven dynamo of a simple type for battery charging. We endeavoured, in the short time available for design, to get out a suitable type, but were not able to complete it in time. To drive a machine such as this for two hours on end is, however, very exhausting work, and is only a possibility if relays of men are available to take turns, two at a time.

A good deal has happened in the two years intervening since that set was sent out, in the development of economy valves, and also in the design of special types of dry or inert cells for working them. The advent of Broadcasting has given a great impetus to this work, and there is no doubt that there will very soon be available on the ordinary commercial market a number of very useful types of inert or special types of dry cells for working these low-temperature valves.

Another point which has impressed me in the paper is the fact that this long continuous-wave work is absolutely the thing to aim at, and it is a question whether for long-distance work one ought to bother in future about spark signals at all, although the spark signals are still of great value to mariners and others. The paper has shown that continuous waves have an enormous advantage where a great deal of atmospheric interference is experienced, and it is of interest to know that the time signal stations now apparently have a tendency to group themselves in what is to us quite a narrow band of wave lengths between 12,000 and 24,000 metres and to work on C.W. It suggests that it should be possible nowadays to design a very simple set working entirely on continuous waves, and coming down in weight and bulk very much less than the sixteen porter-loads—which figure has rather horrified me—that formed Captain Boulnois' set.

The present position of the technical development of wireless reception is of considerable interest. You have economy valves being developed by practically all the valve firms, together with special types of cells for lighting them. Amplifiers too have improved tremendously since that particular type was sent out to the Commission. It is interesting to realize that the amplifier Captain Boulnois had worked satisfactorily on the Bordeaux and Lyons wave-lengths, because it was not designed for long continuous-wave stations at all, but for the shorter waves of Paris and Berlin, and its efficiency on the longer waves was rather low. One can say without hesitation that it would be possible at the present time to design an amplifier for these long-range continuous waves using three valves instead of the five or six which Captain Boulnois had to use. That means a great economy in batteries and corresponding ease in the maintenance of the sets. There is still a wide field open in designing these sets, and I would like to emphasize the fact that we are glad to have any scrap of information relating to reception of time signals in different parts of the world. It helps enormously in design, and the surveyor and explorer can always co-operate with us and help us on the actual technical side by passing on or publishing any information affecting the reception of wireless signals in different parts of the world. Information relating to the amount of atmospheric interference, the fading of signals, and the effect of mountains or jungle on the strength of signals is of considerable importance, quite apart from questions such as suitable pack-loads, or the behaviour of batteries or apparatus under adverse conditions.

The PRESIDENT: Admiral of the Fleet Sir Henry Jackson, whom I think I may without impertinence describe as the father of wireless in the Navy, is present, and there is one aspect of the question which has been discussed this afternoon on which I should like to ask him for his opinion. Great stress has been laid upon the necessity of directing the receiving aerial accurately towards the transmitting station. In view of the well-known difficulties of direction-finding by wireless, I would like to ask Sir Henry Jackson whether he agrees with Captain Boulnois and also with Major Aston in the stress which they lay upon that necessity.

Admiral of the Fleet Sir HENRY JACKSON: I had the privilege, about three years ago, of visiting Woolwich and seeing the apparatus that Captain Boulnois has described and which he has used in Africa. The use of this apparatus was only a secondary, or minor, part of his work there—his work was surveying—but I am glad to find that it really was of value, and I think he has put very clearly the reason why it was of value when he got into that bush country. It saved the erection of high triangulation posts, though possibly if he had used them for his aerial masts he would have obtained stronger signals. The apparatus as I saw it was designed to be as simple as possible and also portable. Woolwich did not know, possibly, whether it would be donkeys, oxen, camels, or men that would carry the apparatus, but they know now, though it is rather too late. I happened, however, to be at Woolwich a fortnight ago, and saw the new designs of apparatus they are making for the Army, and portability and weight are very carefully considered.

During the last few years the amplifier, and consequently wireless signals, have improved out of all proportion, and as long as you have a man who really does understand the work, as Captain Boulnois says you ought to have, you might carry more delicate apparatus and get stronger signals and a larger band of wave-lengths so as to record not only Paris, but Lyons and American signals without great difficulty in East Africa.

As regards aerials and direction, that is not an easy question to answer shortly. There is no doubt that the directive effect of the aerial depends, theoretically and practically (if you put it in proper position), on the cosine of the angle of its inclination to the path of the signal wave. If you vary it but 10° from the direction of the transmitting station, then the change in signal strength will be slight. You have an instance of that in one of the very long aerials which we call the Beveridge aerial. There a matter of 10° is not of great importance. But, as Major Aston said, the signal may not come direct, especially at night; it may come at an angle of even 40° or 50°. Then if you get a difference of 10°, the change in the cosine is very considerable. It may be that on that night when Captain Boulnois could not get his signal from Nauen when his aerial was 10° out of the line, the signal may not have been coming direct. That would possibly prevent him getting the signal. With an aerial long compared with its vertical height, its directive powers are very considerable, approximately varying with the cosine of the angle, as mentioned above. But the vertical height of the aerial adds a constant antenna effect to this. When you use a frame aerial you get direction more accurately; it also varies as the cosine of the angle. When you get into country with many trees you are apt to have the signals very much deflected, and probably weakened, owing to the trees being conductors and absorbing the energy round about the frame aerial, and also putting in errors in direction. But there is no doubt that they are certainly to be depended on in daylight in open country and at sea, and that is one of the reasons why an expert wireless man would be of use in these

expeditions; he would know what type of aerial to use and at what spot to put it, or whether to use the frame aerial, so that he would get the best results under difficult and varying circumstances. You can hardly expect a man who has not studied the question to be able to do this unless he has experience, but I think Captain Boulnois now has that experienee, and will not want an expert with him next time he goes to Africa.

Sir FRANK DYSON (Astronomer Royal): There is very little I can say: in a fixed observatory conditions are so much more easy than they are for a surveyor in difficult country. I quite agree that registration is best if you can do it, and I can imagine that with the half-seconds chronometer it is not easy to receive the rhythmic signals. As he said, the automatic signals are probably the best for most travellers. As regards the accuracy of the signals I can speak with reference to those which came during October from Bordeaux, Nauen, and Annapolis; the possible errors seldom exceeded ·05—a twentieth of a second. So that there is no doubt that travellers can rely on the signals sent out from those three big stations. I believe the Annapolis and Bordeaux signals were very well received by Mr. Dodwell in Australia two years ago. We received them for him at Greenwich in order to give him a comparison, so that he might get a direct longitude from Greenwich. Those signals were received with a little field apparatus; but, of course, I take it it was much easier country than the part of Africa in which Captain Boulnois was working. There is one more point; I quite agree that in all probability the signals as received are more accurate than the astronomical observations made for time, though I have no experience in field work. I think you are quite right in supposing that you need larger apparatus for the astronomical observations.

Mr. W. BOWYER (Superintendent, Time Service, Royal Observatory, Greenwich): In connection with the use of wireless time signals for longitude work, it may be of interest to show the differences found at Greenwich after the signals have been corrected for all known errors, including the small corrections the Astronomer Royal mentioned. A correction may be necessary for certain signals; for instance, Nauen at mid-day transmits simultaneously time signals on 3100-metres spark and 17,900-metres continuous wave. The continuous wave signal was in October, ·06 or ·07 earlier than the spark. Again with regard to the Annapolis Station, the Washington Observatory supplying that signal is connected by land line to the Annapolis Wireless Station, and there was a lag of ·08 normally during October on the land line before transmission of the signal from the wireless station. These corrections have been applied to the signals, and the following table shows the comparisons with time determined at the Royal Observatory. A rather remarkable point is that we get changes in the differences which hold for a considerable period and then go back again. For instance, between January and February the difference for the Paris signal showed a tendency to decrease; a slight increase in May with a decrease again in June, and then up for August, September, and October. Although Paris showed a larger value in May, Nauen showed a decrease; in June there was a greater decrease still, and then a slight rise. Annapolis was much the same, and Bordeaux was in general agreement with the Paris signal. Those differences are somewhat puzzling. It would appear that they are produced in some way by the determination of time, partly at the Observatory transmitting the time signal, and also in part by the Observatory receiving the signal. These results should therefore be taken, not as errors of the time signals transmitted by Paris, Nauen, and Annapolis, but considered, for the present, as a difference in time determinations of two Observatories, which is not yet fully explained.

COMPARISON OF WIRELESS TIME SIGNALS FOR THE YEAR 1923
(*Concluded Results.*)

Month.	*Paris.* 10*h. Rhythm.*	*Nauen.* 12*h.*	*Annapolis.* 17*h.*	*Bordeaux.* 20*h.*
	s.	*s.*	*s.*	*s.*
January	+0.12	+0.07	+0.06	+0.14
February	+0.04	+0.02	0.00	+0.05
March	+0.01	−0.02	0.00	+0.03
April	+0.02	−0.01	+0.01	+0.03
May	+0.05	−0.02	+0.06	+0.07
June	+0.02	−0.09	0.00	+0.06
July	+0.08	0.00	+0.09	+0.12
August	+0.12	0.00	+0.09	+0.12
September	+0.13	+0.06	+0.08	+0.13
October	+0.13	+0.02	+0.11	+0.15

+ means signal late on Greenwich.

Note.—The monthly results given were the means of observations of signals on twenty or more days.

Colonel H. S. L. WINTERBOTHAM: I should like to ask one question. Sir Henry Jackson made a few remarks on the question of the training necessary for an amateur in looking after the wireless set. Major Aston also implied that considerable training would be necessary. If one is allowed to postulate that a surveyor is a person, usually speaking, of normal intelligence, but with particular acquaintance with instruments, may we take it that he can absorb enough knowledge of his wireless instruments in a month to dispense with the services of the wireless expert?

Major ASTON: In answer to your question, it depends very much on the man you select. If you select a man who has got a good electrical knowledge I should think that he would be able to absorb in a month sufficient to be of use provided that he is associated with people who have had experience. If he merely sits down and reads a text-book he will not get very much. A man who has not any really good electrical knowledge might have to study the subject for a year.

Sir HENRY JACKSON: May I say that I quite agree with Major Aston.

The PRESIDENT: Mr. Reeves wanted to say something, but unfortunately owing to illness he is not able to be present. He has, however, communicated to Mr. Hinks what it was he wanted to say, and I will ask Mr. Hinks to tell us what it is.

Mr. HINKS: I should like to say very briefly two things that Mr. Reeves was anxious should be mentioned. Captain Boulnois laid stress in his paper upon the difficulty of receiving rhythmic signals unless you have two skilled observers, or, at any rate, one skilled and one partially skilled. Mr. Reeves has this summer been working with Mr. Weld Arnold, one of his pupils, and they have found that by the simple method of making a pencil tick for every tick coming from the wireless; by keeping an eye on the chronometer and making a stroke up at each minute of the chronometer, and a stroke down for each coincidence between the tick of the chronometer and the rhythmic signal, it is possible for a single observer to get results such as those I show on the screen, from which it will be seen that the divergence from the mean is about two or three hundredths of a second. So that a single observer can reckon upon getting the comparison between his chronometer and the International Time Service right within, say, a couple of hundredths of a second of time, after a little practice and without any assistance.

Mr. Reeves' second point is against the remark Captain Boulnois made, and which has been treated in discussion, on the need for having the aerial carefully orientated. Mr. Reeves recalls the fact, mentioned also by Sir Henry Jackson, that the signals frequently arrive from distant stations, especially at night, with very considerable changes of azimuth, and Mr. Reeves suggests that from that point of view it may be a mistake to discard the frame aerial. An aerial which will sweep for your station may give you stronger results on more nights than you would get with a long fixed aerial. Those are the two points that Mr. Reeves has asked me to bring before the meeting.

If I may add a small point myself, I would ask whether it would not be more convenient to have 301 dots in the rhythmics, so that you divide by 300 instead of 299. Also I would like to ask Mr. Bowyer whether the time signals from Nauen represent an independent determination of time or whether they are, at least in part, a repetition of the Eiffel Tower signals.

Mr. BOWYER: The time signal from Nauen is from time determined at the Hamburg Observatory.

Mr. G. W. N. COBBOLD (Signals Experimental Establishment, Woolwich): There are one or two points I should like to add in amplification of what Major Aston and Captain Hughes have said from the technical point of view. Some time ago I assisted Captain Hughes to design a set for the Geodetic Survey of India. In this we employed a large loop aerial, a type to which no reference has been made so far this evening. Satisfactory results were obtained by the use of large loops in recording the Annapolis time signals at Woolwich, a problem we regarded as being somewhat on a par with that of recording Bordeaux in India. The actual loop employed was 55 feet square and suspended from two 70-feet masts. Although one loses the advantage conferred by the rotatability of the small frame, the directional effect is maintained and the relative signal strength is very great.

With regard to the method of recording time signals, we developed a year or two ago a semi-automatic method of recording: a relay circuit was provided, in which the operator, whilst listening to the wireless signals, worked a hand key. The inker had two marking devices, one of which recorded the chronometer beats, and the other the signals as reproduced by the operator. We found that with a little practice we were able to get a high order of accuracy. If the personal equation of the operator is carefully determined, by supplying him with imitation time signals produced locally, we estimate that an accuracy of about a fiftieth of a second can be obtained.

Sir Henry Jackson has already pointed out that the exact direction of the aerial is not so important as would appear from the paper, and I think that the wipe-out phenomenon which Captain Boulnois observed on one occasion when his aerial was 10° off the great-circle bearing was due to "night effect." In fact, as Major Aston has already suggested, if the aerial had been moved to a position some way off the great-circle bearing on the opposite side, an increase of signal strength would probably have occurred.

With reference to Captain Boulnois' suggestion for a new method of recording signals, considerable technical difficulties would be involved in providing that only those signals which come through at the moment of a chronometer tick should be heard. But, apart from these difficulties, it appears to me that the method is not really a good one, for it surrenders the great advantages which result from the hearing of the whole group of dots. Even when the simple aural method is being employed, great use can be made of dots that occur on either side of the coincident point. Owing to atmospheric disturbances the

coincident point itself may be entirely lost, but if the pairs are heard closing up on one side and opening out on the other, a very fair idea of the position of the coincidence point may be obtained by the vernier method.

The PRESIDENT: Time is somewhat late and I do not propose to add anything to the discussion, but merely to express the gratitude of this meeting to Captain Boulnois and others who have taken part in the discussion, one which I think has been of great interest and should certainly prove to be one of considerable practical value. We thank you for your most excellent paper.

Note added after the discussion by Mr. Reeves.

For an observer without a reliable assistant, the following method of recording the rhythmic time signals is perhaps simpler than any other, as it has the advantage of setting him free from the necessity of counting or marking down the dots, since the counting is done by the chronometer.

All that is required is to note down the chronometer time of the first dot to the nearest estimated tenth of a second, then the times of the coincidences as they occur, and finally the time of the last dot as near as possible. Later on, when they are sent, the sidereal times of the first and last dots are noted as usual. If considered advisable as a check, the chronometer time of some other known dot may also be noted down, and the most convenient to take is one of those immediately following one of the long double dots, such as the 182nd or 242nd.

As there is generally some uncertainty as to the exact coincidence dot, it is well to write down three or four that appear to be correct and take the mean.

The differences between the times of the first or last dot and the chronometer coincidence times are, of course, the intervals in mean time seconds, and these can be readily converted into the corresponding dot intervals by adding to each 1/44 of itself. Since the chronometer is only used in this operation to count the whole dots, or intervals, any decimals are finally rejected, dot intervals and coincidence times being both taken to the next less or next greater whole second. They must be both moved the same way. All doubt as to whether the next less or next greater is the correct interval is set at rest by the result, since if a mistake has been made in any one, the resulting error of the watch will be quite inconsistent with the others. Having obtained the dot intervals and the corresponding chronometer times, the error of the chronometer is computed in the usual manner.

By this method the observer is free to concentrate his attention on the chronometer. In the example given a mean time watch was used of which the beats could not be heard distinctly, and the times were noted by sight.

The same method of finding the interval between the dots holds good when a sidereal time chronometer is used, only in this case the intervals in chronometer seconds must be increased by adding 1/52 of itself to each, instead of 1/44 as before.

Then rejecting decimals and multiplying the resulting whole number by the proper multiplier corresponding to the difference between the sidereal time of the first and last dots sent by wireless, the sidereal interval from the first or last dot is obtained.

In the case of the sidereal chronometer the resulting sidereal intervals added to the sidereal time of the first dot, or subtracted from that of the last dot, is the sidereal time of the coincidence, and the difference between these and the corresponding chronometer time (to the second only) is the error of the chronometer on Greenwich sidereal time.

As regards the L.M.T. observations and the much-discussed question of the theodolite *versus* the prismatic astrolabe for observing equal altitudes, all I will say is that after considerable experience I have come to the conclusion that better results can be obtained with the prismatic astrolabe. It is not an easy instrument to use and requires a lot of practice, and the trouble of preparing a list of suitable stars, with their times and azimuths, is a drawback; but for really accurate work I have no doubt that it is the instrument to use in the field, provided weather conditions are suitable.

Some of my pupils have lately done very good work with it, or rather with the prismatic astrolabe attachment fitted to a theodolite which I designed some time ago.

THE MOUNT EVEREST EXPEDITION OF 1924

BY the time this *Journal* is published the Third Mount Everest Expedition will have left Darjeeling and be on its way up the Chumbi Valley to the plateau of Tibet. The article by Mr. Freshfield which we published last month sums up the general situation at the outset of what we hope and believe will be the final assault ending in the conquest of Mount Everest. We have now but to give some details of the party and their equipment.

The Mount Everest Committee were fortunate in finding General Bruce, the leader of the 1922 Expedition, fit and able to go again. He has with him six of the 1922 party, including the three who made the first high climb without oxygen, Lieut.-Colonel E. F. Norton, D.S.O., R.A. (who will be second-in-command), Mr. George Leigh Mallory, and Mr. T. Howard Somervell. Captain Geoffrey Bruce, 6th Gurkhas, and one may hope Corporal Tejbir, two of the three members of the second high-climbing party, are joining the Expedition at Darjeeling. Captain C. J. Morris, of the 3rd Gurkhas, will again be one of the transport officers, and Captain J. B. L. Noel, who made the celebrated kinematograph record of the last Expedition, will again be the official photographer. To the strong nucleus of four tried climbers with the experience of last season to guide them, the Committee have been able to add four other climbers of the first rank, though without previous experience in the Himalaya: Mr. N. E. Odell, of the Imperial College of Science; Mr. Bentley Beetham, of Darlington; Mr. A. C. Irvine, of Merton College, Oxford, who rowed in the Oxford boat in 1923; and Mr. J. de V. Hazard. Major R. W. G. Hingston, I.M.S., will be the medical officer and naturalist; and Mr. E. O. Shebbeare, of the Indian Forest Service, will share with Captain Bruce and Captain Morris the duties of transport officers.

The Committee are greatly indebted to the authorities who have been generous in granting leave to the various members of the Expedition; to the Territorial Association of Glamorgan, who have spared General Bruce for a second time; to the War Office, who have given

Colonel Norton leave from his duties with the Artillery; to the University of Cambridge, who have allowed Mr. Mallory leave only a few months after he had taken up an important appointment at Cambridge; to the Commander-in-Chief in India and the Governor-General of Bengal, who have spared Captain Bruce, Captain Morris, and Mr. Shebbeare; and to the Air Ministry, who kindly released Major Hingston from his charge of the R.A.F. Hospital at Baghdad, that he might accompany the Expedition.

The Committee are further indebted to the Government of India for their good offices in obtaining, through the Political Officer in Sikkim, the consent of the Dalai Lama to the passage of the Expedition through Tibet, and to the Government of India also for free entry into India of all the expedition stores.

The oxygen equipment has been redesigned. A new type of cylinder has been manufactured by Messrs. Armstrong, Whitworth & Co., Ltd., and after tests by the National Physical Laboratory and the Research Department, Royal Arsenal, has been adopted upon the advice of Messrs. Riley, Harbord, and Law. Three cylinders will carry 50 per cent. more gas than four cylinders carried in 1922 without any increase in weight. The carrying frames have been made on the pattern of those supplied in 1922 by the Bergans Meis og Rygsæk, of Christiania, which proved so successful, and the greatest possible care has been given by the makers, Messrs. Siebe, Gorman & Co., to all the details of the valves and regulators. The Committee are specially indebted to one of their number, Mr. P. J. H. Unna, who has been responsible to them for the control of the design and manufacture of the apparatus. Mr. Unna has also given much attention to the supply of stoves, thermos flasks, and other high altitude equipment, and special cooking apparatus for use in rarefied air has been made by the Meta, S.A., of Basle. The supply of tents, sleeping-bags, windproof clothing, high altitude climbing boots, etc., has been superintended by Colonel Norton, and the committee are indebted to Messrs. Edgington (tents and bedding), Messrs. Burberrys (windproof clothing), and Messrs. Fagg (boots), for the care which they have given to the special requirements of the Expedition. They have also to acknowledge the assistance in many ways of the Army and Navy Stores, who have not only supplied and specially packed all the food, but have undertaken the shipment of the whole of the stores and their despatch from Calcutta to rail head at Kalimpong Road.

The Committee have also to acknowledge with gratitude valuable gifts of stores from the following firms: Messrs. Allen & Hanburys, Ltd., Medical Stores; Messrs. Brand & Co., Ltd., Medical Stores; Messrs. Bovril, Ltd., Bovril, etc.; Messrs. Carsons, Ltd., Chocolate, etc.; The Ever Ready Co., Ltd., Torches and batteries; Messrs.

Howards & Sons, Ltd., Medical Stores; Messrs. Meta, S.A., Stoves and Meta Fuel; Messrs. Virol, Ltd., Virol and Virolax; Thermos, Ltd., Thermos Flasks.

The instrumental equipment of the Expedition is very similar to that of two years ago. They are taking with them a 3-inch theodolite by E. R. Watts & Sons; aneroids by Cary-Porter and Short & Mason; thermometers by Casella & Co. and Negretti & Zambra; liquid prismatic compasses by Short & Mason; and Kata thermometers by Hicks. Various special apparatus for physiological research at high altitudes has been lent to Major Hingston by the Medical Branch of the Air Ministry. Captain Noel takes with him the same kinematograph camera by Sinclair, but with considerable special improvements.

In short, no trouble has been spared to equip this Third Expedition after fullest consideration of the experiences of previous years, and the Committee feel confident that if only the weather is kind we shall learn this year the extreme of human possibility, which it may be predicted will not fall short of the summit.

MOUNT OLYMPUS

Le Mont Olympe (Thessalie).— Marcel Kurz. Paris: Victor Attinger. 1923. 10 × 6½, pp. x. + 232. *Illustrations and Two Maps.*

IN his note on "The Summits of Olympus" (*G.J.*, **47**, 293, April 1916), Mr. Freshfield complained that the information given by the narratives and diagrams of recent travellers is not only scanty but contradictory. He has now had the satisfaction of writing a very appreciative preface to the extremely good monograph by M. Marcel Kurz, which it is our pleasure to commend as a model of what such a monograph should be: well written in terse and lively French; fully documented, scrupulously fair, sufficiently illustrated, and adorned by two maps—the Larissa sheet of the Austrian 1/200,000 for the general geography, and a splendid new map of the massif from a stereographic survey by the author on the scale 1/20,000, contoured at 20-metre intervals.

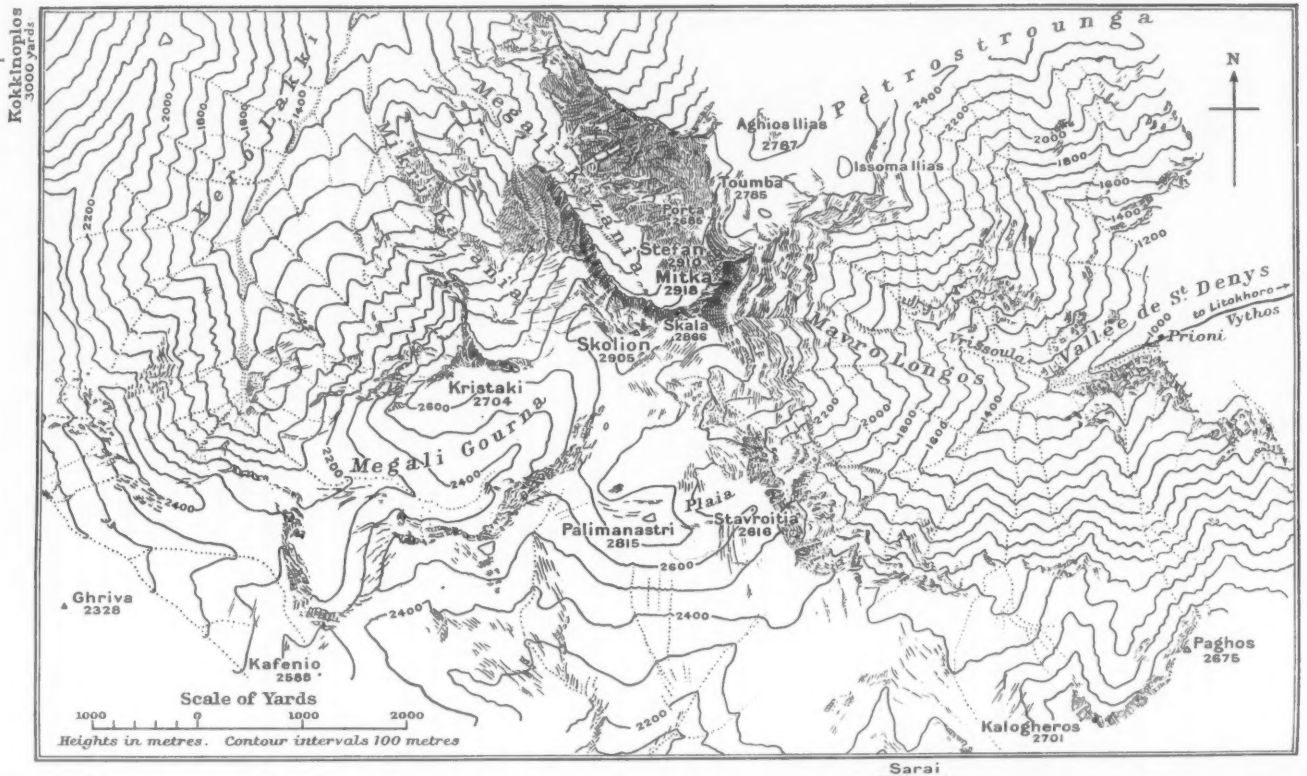
In the interval between 1916 (Mr. Freshfield's article) and the end of 1923 (M. Kurz's book) we had published an article by M. Baud-Bovy (*G.J.*, **57**, 204, March 1921) with a sketch-map of the mountain (drawn at the R.G.S. from material supplied by the author) which was a great advance upon any map of the summits then existing, but which, as we now can see, was far from right. M. Kurz commends the sketch, but is severe upon the efforts of M. Baud-Bovy to bring order into the nomenclature of the mountain by proposing a set of descriptive names in French, and a few personal names, including that of M. Venizelos for the highest point: upon which efforts "l'editeur du *Geographical Journal* a du reste exprimé des reserves." Confusion of names is a principal difficulty in disentangling the topography of the various travellers who have given incomplete accounts of the mountain. At least three peaks have been called Kalogheros (the Monk). The name of St. Anthony given by Barth to one has been misplaced upon another. There has been more than one St. Elias. Moreover, there are at least four peaks so nearly the same

in height that it was impossible without precise survey to be sure which was actually the highest; and one a good deal lower which so good a geographer as Cvijić confidently declared was the culminating point.

While the mountain remained on the Graeco–Turkish frontier its neighbourhood was the convenient resort of brigands. A few travellers in the nineteenth century, bolder and more fortunate than the rest, made hurried reconnaissances: the last visitor under the old *régime* (in 1911) was held captive for several months by the genial Liolios, whose portrait (in what looks like a British officer's uniform) appears opposite page 112. Having extorted at least £19,000 in gold from the Turkish Government as ransom for the unfortunate Herr Richter, "il s'est retiré actuellement à Karadjoli près de Tirnavos, où il vit paisiblement de ses rentes, marié et père de famille." But in 1912 the Turkish frontier was thrown back to the north. The mountain became at last accessible, and in 1913 MM. Baud-Bovy and Boissonnas of Geneva reached its summit—a fact which they kept to themselves until 1919. Then came the visit of Messrs. Farquhar and Phoutrides, whose account in *Scribner's Magazine* inspired Mr. Freshfield's article in the *Journal*. At the end of the war Colonel Wood made a reconnaissance by air from Salonika (discussed by Mr. C. F. Meade in *Alpine Journal*, No. 219), and in 1919 "nos incorrigibles Genevois," as M. Kurz of Neuchatel calls them, returning to the mountain, made the photographs and sketch which we had the pleasure to publish in 1921.

For some years, therefore, we have had a wealth of admirable photographs without being able to fit them properly into place, because survey was entirely lacking, or at least unavailable. About 1920 the Greek military surveyors, under the orders of General Fothiades, in the course of a triangulation of Thessaly and Macedonia, fixed a first-order station on Skolion, and a dozen beacons of the third order in other parts of the massif. "De ce fait, l'Olympe pouvait être consideré en 1920 comme la contrée la mieux triangulée et la plus mal topographiée de toute la Grèce." But now at one stroke, in a few weeks' leave with a borrowed photo-theodolite, M. Kurz has transformed Olympus into the best-mapped mountain in the world—or very near it: an inspiriting performance to be applauded and discussed, as it will be; but above all to be imitated widely, as it should be. In the first enthusiasm for the performance one must not overlook the long and patient work that the author put into those plates after he returned from leave to his duties as a member of the Swiss topographical mission operating in Greece; nor the admirable engraving by the Service topographique Suisse, and the rock drawing by M. Ch. Jacot-Guillarmod. But the actual photography in the field took just eleven days. There is no longer any excuse for a country owning a distinguished mountain to leave it unsurveyed.

And now at last we are able to follow intelligently the routes of the various travellers, and to understand their photographs. The river Vythos, running due east from the centre of the mountain mass through the valley of St. Denys to the Gulf of Salonika at Litokhoro, has excavated an immense cirque with steep rocky slopes averaging about 50 vertical to 100 along the slope: what we will call for short a 50 per cent. slope. The ridge of Petrostrounga forms the northern crest of this cirque. Perched up beyond the crest on the north-west is the small high basin Issoma Ilias (the Prairie des Dieux of Baud-Bovy), and standing rather alone on its far side the gentle peak of Aghios Ilias (St. Elias). High up on the western crest, at the eastern foot of the steep piles of rock that form the highest summits, is a narrow gully or corridor which makes a convenient way from north to south, from St. Elias and Toumba (Pic Jacques



Sketch-map of the Summits of Olympus, reduced from the Stereo survey of M. Kurz.

Philippe of Baud-Bovy) to Skolion and the southern plateau. The northern scarp of this plateau makes the southern edge of the Vrissoula (Upper Vythos) cirque, several hundred metres lower than the opposite crest of Petrostrounga, and the line of peaks—Sarai, Kalogheros, Paghos *—lie back to the south a mile or two, leaving a high dry plateau rising not very steeply westward and north-westward to the line of westward peaks, Palimanastri, Kafenio, and Ghriva.

The highest summits—Stefan and Mitka (the Throne of Zeus and Pic Venisélos of Baud-Bovy)—look down eastward very steeply into the cirque of the Vrissoula, but precipitously westward into the deep cwm of Megali Kazania, running in from the north-west to the magnificent cliffs now familiar to us from the photographs of Farquhar and Boissonnas. The crest of this cwm, running south-west from Mitka to Skala (the Tête noire of B.-B.) sweeps westward through Skolion and turns north-west down the steep arête (60 per cent.) at first, and then much steeper, to the wooded ridge between the Megali and Mikri Kazania, and so to the Xero Lakki (Kuru dere of Cvijić) or dry valley. Away westwards is Kokkinoplos—the most convenient base for a prolonged study of the massif—a large village lying a little east of the old main road from Katerini to Elasson.

We can now, in the light of M. Kurz' examination, briefly summarize the achievements of the principal visitors to Olympus. The account given by Urquhart (1830) leaves it uncertain whether he reached Sarai, or one of the spurs of Skolion ; he came from Elasson by Tsaritsani. Heuzey (1855) passed along the southern flanks, probably climbed Sarai (which he called Itchouna), and later attacked the mountain from Litokhoro by the gorge of St. Denys and Mavrolongos. His map is fantastic and his descriptive topography insufficient. He came in sight of St. Elias, which he considered the summit ; not even M. Kurz can follow his route ; but " nous pourrons constater la répercussion de ses erreurs pendant un demi-siècle encore."

In 1862 Barth, the great African traveller, started from Kokkinoplos, reached Kafenio, passed south of Skolion without ascending it, looked down into the north-west cwm from the south-east arête of Skala, and followed the corridor east of Mitka and Stefan to the summit of St. Elias, very annoyed with Heuzey because it was evidently not the highest point. Returning by the same route, and turning eastward, he descended with difficulty to the sawmill of Prioni, and so to Litokhoro.

In 1865 Tozer, from Katerini, reached the monastery of St. Denys in the gorge above Litokhoro, and thence climbed straight up on to the crest Petrostrounga, which he followed westward to the summit of St. Elias, from which he viewed the peaks Stefan and Mitka, and resolved to climb them on the morrow, but could not persuade his men to bivouac, and was obliged to return to the monastery of St. Denys.

History is then silent until 1904, when Prof. Cvijić traversed the flanks of the mountain, and in the year following examined the geology of the central massif. He compares the " Three Brothers "—Stefan, Mitka, and their companion—to the Drei Zinnen, but makes the curious error of taking Kristaki for the highest peak. It does not appear however, in M. Kurz' summary, that Cvijić climbed any of the higher peaks.

We come now to 1911, and to " les tribulations de la police ottomane à la

* These peaks are nearly 1000 metres higher than they are shown on the Austrian 1/200,000 : an extraordinary example of the unreliability of that map.

Sketch-map of the Summits of Olympus, reduced from the Stereo survey of M. Kurz.

recherche de l'ingenieur allemand Edwart Richter." In 1909 he had climbed Palimanastri alone; in 1910, from Kokkinoplos he had reached the summit of Kafenio, and been driven down to St. Denys by bad weather; in 1911 he fell into the hands of the brigands, having failed in three attempts to get on to either of the higher peaks. His troubles comprised all the impediments which for so long defeated the travellers: faint-hearted guides, bad weather, but chiefly brigands. In 1912, with the Greek victory over the Turks, the frontier was removed far northward; the brigands could no longer operate securely; and the way was open at last to the Throne of Zeus.

The first account of the conquest of 1913 appeared only in 1919, in a single chapter of *La Grèce Immortelle* (a book of lectures published with illustrations by M. Boissonnas of Geneva). "Comme les conférences qui l'encadrent," says M. Kurz, "celle de Baud-Bovy affecte un ton volontairement lyrique, aussi l'auteur n'est-il pas toujours facile à suivre, à travers ses descriptions imagées." The second and even more successful visit of MM. Baud-Bovy and Boissonnas, in 1919, was briefly described by the former in his paper in the *Geographical Journal* (*loc. cit.*). So ended rather inadequately the tale of the conquest of Olympus, until it was elucidated by the admirable topographic description and the beautiful map of M. Kurz. The description must be read in his graphic pages. We have taken leave to make a reduced sketch from his map, to illustrate this imperfect summary of a monograph that has given us especial pleasure: and, not least, the careful chapters on the cartography and nomenclature.

A final word must be said on the technique of the stereo-survey. Ten days' work with the photo-theodolite gave twenty stations, interpolated by triangulation from the beacons of the Greek survey, with stereoscopic bases of 50 to 250 metres measured tachymetrically. The whole apparatus was carried on two mules. The plates were measured with a Pulfrich stereo-comparator, and gave 3200 points, or 30 to 40 per square km.; the height of each point was written on the map and on the photographs, and the contours were interpolated with the stereoscope. The gaps not covered by the stereo-survey were insignificant, and the mean error is estimated at no more than 3 to 4 metres in position, and 0·5 metre in height. This latter estimate must refer to "spot heights"; there are one or two places on the map where the contours are inconsistent, or where one is by accident omitted; and it would be most instructive to see one or two of the pairs worked out on the stereo-autograph, for comparison. That may be for the future. For the present we must whole-heartedly congratulate M. Marcel Kurz on the completion of a really firstrate piece of work, and express the hope that his abilities may find worthy employment in further work of the kind. A. R. H.

RODRIGUEZ ISLAND

The Island of Rodriguez: a British Colony in the Mascarenhas Group.—A. J. Bertuchi. London: John Murray. 1923. 8½×5½, pp. 112. *Map and Illustrations.* 9*s. net.*

THE author during the War lived in Rodriguez for three years, and as an act of "duty" compiled this small book "being aware of the non-existence of a work on this little-known colony." It is a mistake to cultivate a conscience where the required impulse must be the joy of life. The author

felt delight in his task, but conscience was demanding a gazetteer, and the result is a hybrid compilation with a pleasant personality severely restrained. Surely there were some books dealing with Rodriguez in " Government House " or elsewhere that might have been consulted, such as the Royal Society's volume on the Transit of Venus Expeditions of 1874–75, dealing with the geography, animals, and plants observed (*Phil. Trans.*, vol. 168. Extra Volume, 1879); or the Newtons' descriptions of the Solitaire. There must, too, be Government records either at Rodriguez or at Mauritius that might have been consulted. We should welcome another book by the same author about a second wild station of the Eastern Telegraph Company, if only he would write what he sees and feels. The present book is an up-to-date account of Rodriguez as it is.

Rodriguez lies 300 miles east of Mauritius, being the most easterly of the three volcanic eruptions which visibly marked the south-eastern part of the Mascarene area. While Mauritius and Reunion are connected by comparatively shallow water (under 1000 fathoms) to Cargados, to the Saya de Malha Banks and to the granite Seychelles Group, Rodriguez is quite isolated, encircled by over 2000 fathoms of sea, and thus shows no clear topographical connection. Reunion has an active volcano of 8613 feet, Mauritius has three mountain masses of over 2000 feet, while Rodriguez has a central core of volcanic rock of only 1300 feet. The island has obviously been forced up, for the greater part of its 42 square miles of land is covered with coral rock up to 530 feet above sea-level, much carved by comparatively heavy rainfall. It is now in a quiescent period, the island having broad reef flats north, south, and west, the prevailing strong winds being from east to south-east. The island is periodically subjected to hurricanes which may be productive of good rather than harm, as three weeks after a particularly severe cyclone " the island had quite recovered, the trees were again covered by foliage and everything seemed to grow quicker."

The first account of Rodriguez was given by François Leguat, who settled there with seven companions in 1791, abandoning the settlement three years later. It was then almost completely covered with large trees, a regular tropical jungle, with rich thick soil beneath. Most of these trees were of species peculiar to the island or to the Mascarenes. Gorgeous blue and green paroquets flew through their branches, while large lizards of gaudy hue loaded their tops. Thousands of giant tortoises, weighing up to 300 lbs., cut lanes between the stems of the trees, paths used also by the large upstanding flightless solitaires, birds similar to the dodo of Mauritius, which was of a much more squat form. Streams, perpetually fed by the forest sponge, gave an abundant and constant supply of water, and cut ravines with cascades. Some thirty species of land shells there were, but insects were few, and there were originally no rats and mice, flying foxes being the only mammals. Land crabs were a nuisance, but the sea gave an abundance of fish, and to the true colonist the place would have been " a miniature of the paradise that the angels inhabit," as Leguat says.

Contrast this with its present condition: its jungle destroyed, and prevented from reforming by goats and pigs; its indigenous trees of any size found only in ravines and pits in the coral rock; most of the jungle soil washed into the sea, leaving bare rock; its streams either dry or forming torrents in seasons of rain; half its area turned into more or less open grazing ground for cattle, while the rest is largely planted with casuarina (filao) and acacia as ugly as their forerunners were beautiful. The contrast drives home the imperative

necessity for the complete preservation of the mountain jungle with its absorptive sponge to protect the lands below alike from excessive moisture and from drought. The solitaire (the last recorded in 1731) and the land tortoises (used to victual Mauritius) are both no more, and are replaced by deer, goats, wild cats, rabbits, and rats, while red-legged partridges and guinea fowl find a home on the now bare lands.*

The people, who number about 6500, are mainly of mixed French and negro descent, many quite white again after several mixed generations, allied to the Mauritian creoles. The number of whites in the villages is stated to be singularly large, and the whole island to be free from fever and very healthy. It is a dependency of Mauritius and a station of the Eastern Telegraph Company on its imperial chain to Cocos-Keeling and the East, and it was, we believe, the first to flash the news of the *Emden's* arrival there.

Salt fish, live stock (cattle, sheep, goats, pigs and poultry), tobacco, haricot beans, and acacia seeds are exported for use in Mauritius, while rice, drinks (tea and wines), clothing, and sugar are the chief imports. Maize is extensively grown, as well as manioc and a variety of vegetables and fruits. Garlic grows well, and with its new use as an antiseptic may become of financial importance. All this, pleasantly amplified and well illustrated, together with personal observations on the natives, make Mr. Bertuchi's book excellent reading for those who are interested in the less known parts of our Empire.

J. STANLEY GARDINER.

REVIEWS

EUROPE

The Archæology of the Cambridge Region : A Topographical Study of the Bronze, Early Iron, Roman, and Anglo-Saxon Ages, with an Introductory Note on the Neolithic Age.— **Cyril Fox, Ph.D., F.S.A.** Cambridge: University Press. 1923. 9½ × 6½, pp. xix + 360. *Five Maps in Pocket and nine in text. Many Illustrations.* 31*s.* 6*d. net.*

DR. CYRIL FOX has written a book which will be a landmark in the history of archæology. It would be difficult to praise it too highly.

* That the island was entirely covered with jungle in Leguat's time may perhaps be questioned. Sir Edward Newton, a well-known naturalist and colonial administrator and brother of Prof. Alfred Newton, the ornithologist, visited the island in 1864. (He then entered three of the large caves and picked up bones of the Solitaire and of the large Land Tortoise.) In his journal, now in the writer's charge, under date 6 November 1864, there is the following entry: " There is no forest as far as I could learn, but Mr. Jenner, Resident Magistrate, says it was destroyed 40 or 50 years ago by fire. This I doubt, as in so short a time there would surely be some traces of the fire still left, and there are none; and I have very little doubt that in Leguat's time even there was no wood—indeed, that the island has not altered much since then; and his plan of his settlement with the trees dotted about is just the same as at present." Fire is the easiest agency of destruction to imagine. The writer in 1905 and 1908 saw no traces of the large fires supposed to have devastated Mauritius and the Seychelles Islands, and is frankly sceptical in respect to them, especially in the Seychelles. The charcoal layers he found can be explained by the subsequent burning of dead bush and timber after having been cut by man. Newton, who visited Seychelles about 1868, refers to the giant stems of dead Capucin trees standing up in the untouched jungles, in a manner similar to those described by the writer; they show no trace of having been killed by fire.

The unit of study is a region about 700 square miles with Cambridge in the middle. The treatment is chronological and geographical. A chapter is devoted to each of the five periods, and for each there is a special coloured map in a pocket at the end of the book. A separate chapter describes ancient earthworks and trackways, and another gives the author's conclusions. Three appendices of lists, a bibliography of books referred to, and index complete a most scholarly undertaking. Dr. Fox is erudite but he is no pedant, and therefore his book is easy to read; his judgment is independent and sound, being backed by thorough knowledge of his subject; and his attitude is critical but not controversial. But we regard Dr. Fox's book as epoch-making, because it combines erudition and sound judgment with a truly geographic insight into the past. It is a truism that in order to understand any period—past or present—one must visualize the environment in which the people of the period lived or live. Previous attempts to visualize the environment have been slight, and often backed by only the most rudimentary archæological knowledge. Dr. Fox has succeeded because he has taken a manageable region, and because he is well grounded in the grammar of his subject. The essential and most original features of the book, and those round which it is written, are the five coloured maps, on a scale of 4 miles to the inch. The basis of each is the Ordnance map, coloured to represent the original natural vegetation of the district—open country, probably for the most part grass-land, which is left white; dense forest shown in green; and fen shown in brown. The ancient meres are restored, and the rivers emphasized, in blue. This geographical background represents with very fair accuracy the environment of all the successive pre-Roman populations; and it accordingly appears on all the maps. Upon each of them the human elements are then overprinted in red; the find-spots of stone, bronze and iron implements, and the sites of the settlements, graveyards and the like, are indicated by appropriate symbols. One map, one period—that is how it should be done; and that is how Dr. Fox has done it.

History looked at thus geographically is seen sometimes to repeat itself, and the reasons hardly need verbal elaboration, for they suggest themselves when one studies the maps. When the facts are thus geographically presented, the inferences follow naturally and almost inevitably. The forest region of "secondary settlement" was one that can only be effectively occupied when a certain standard of civilization is reached (p. 314). Accordingly we find it uninhabited—or at best sparsely inhabited by "backward" hunters—in all except during the Roman and mediæval periods. The barbarian invaders selected easier regions of "primary settlement" both in prehistoric and post-Roman times; and since the Cambridge region lies open to the North Sea with navigable rivers penetrating inland, it has borne the brunt of at least three invasions. Attention is drawn to the sharpness of the break in culture at two distinct periods—between the Middle and Late Bronze Ages, and between the Roman and Saxon periods; and it is suggested that similar causes may have been at work. The shifting of the economic centre of gravity, when the bronze-producing west began to lose its hold, may have been a contributary cause in raising the level of culture in the Cambridge region, and must certainly have affected it by altering the course of the main trade routes (p. 319).

Dr. Fox does not always express his meaning quite as clearly or as tersely as he might; perhaps the impending scrutiny of examiners may have been responsible. It is to be hoped that he may be enabled to produce a book with wider scope; a text-book of British Archæology is urgently needed by students,

for no such exists at present. We congratulate the author upon his present achievement, and the Syndics of the Cambridge University Press for their share, no small one, in it; the general appearance, type and illustrations are excellent and pleasing to the eye. We must also bestow a word of thanks on those who had the insight and generosity to make possible the printing of the coloured maps, which, as Dr. Fox says, are essential to his scheme.

O. G. S. C.

In Greece: Journeys by Mountain and Valley.— Text by **D. Baud-Bovy**; preface by **Th. Homolle**; photographs by **Fred. Boissonnas.** Geneva: Editions d'Art Fred. Boissonnas. 1920. Size 15 × 12. *Price* £12.

The beautiful photographs, as admirable for their selection and the viewpoints chosen as for the success of the reproductive process used, which are the occasion of this sumptuous publication, were made by M. Boissonnas a long time ago, long, indeed, before the war, in the course of two tours in Greece; and enlargements of the original plates were on view in Paris during the Peace Conference. They now appear with a translation of M. Baud-Bovy's rather rhapsodical letterpress and an explanatory preface by the Director of the Louvre. About the photographs, when one has said that they are just as good as they could possibly be; that they range from Ithaca to Sunium and from Taygetus to Tempé and Metéora; that if, as has been maintained, appreciation of scenic beauties is part of a geographer's functions and equipment, they make a notable contribution to geography; and that, well as one may know Greek hills, valleys, and monuments, one finds unfamiliar and most instructive points of view in these photographs. When all that is said, there is nothing left to say except that one wishes there were more of them! One would have liked some more of the temples, *e.g.* the Theseum and Phigaleia; one would have liked Taygetus from the sea instead of from Sparta, Pelion from the Gulf of Volo, the grand wall of Pindus from the crest above Metéora, and Olympus from the Thermaic Gulf. One would have liked a dozen other views, but would not willingly have spared for them any one that M. Boissonnas has given us.

The letterpress of M. Baud-Bovy is another matter, about which the best to be said is that it is enthusiastic tourist stuff by a neophyte in Greece. It does not help the illustrations. But it should be allowed that compositors or proof-readers to whom English was evidently unfamiliar, and a translator who, if he or she knew what the author's French meant, has often conveyed no meaning at all to the English reader, have not given M. Baud-Bovy a fair chance. The abundant crop of misprints might be condoned, even when it offers something so cryptic as "did tot scar a dictatorship" (which sentence conceals some stricture on Capodistria); but it is not the printer who is to blame for such obscurities as appear *e.g.* on p. 26, "in front of the Parthenon the living force of the divine landscape seemed to have its beginning and its end." We have not the slightest idea what this means, and are sure that the translator was equally in the dark.

D. G. H.

ASIA.

Here and There in the Historic Near East.— **R. Martin Pope.** London: The Epworth Press. 1923. 7½ × 5, pp. 156. *Illustrations.* 3*s.* 6*d. net.*

The author modestly disclaims any great value for this collection of "travel-sketches." Written for the most part in 1919, and rigorously pruned since of much topical allusion, they form a pleasant narrative of wanderings in

Macedonia, Thrace, and Anatolia. Mr. Pope is an observant traveller, his style is compact, and his interests are wide. Balkan politics do not obtrude themselves unduly in his pages. His main concern lay in tracing out the main movements of history against their actual background, strange and yet well known to him as a student. Salonika, despite its air of modernity, Amphipolis, with its memories of Thucydides, Constantinople, and, above all, Troy, cast their varied spells upon him. Nor did he share their delights alone: at Troy, as an army educational officer, he succeeded in awakening in others something of that interest, even enthusiasm, in the past which won for him the nickname "Pope of Troy." So rapidly have events moved in the Near East, that his final chapter on "People, Politics, and Religion" is already out of date, but the soundness of his observations remains unshaken. Much of his optimism for the future is based upon his regard for the qualities of the Turkish peasant, given suitable leadership and training.

The Cultivation of Sugar Cane in Java.— R. A. Quintus. London: Norman Rodger. 1923. 10 × 6½, pp. xii.+164. *Map and Illustrations.* 12*s. net.*

The author, who is manager of the Krian Sugar Factory, has written "an elementary treatise on the agriculture of the sugar cane in Java," with special reference to the Krian sugar estate. The volume appears to be most comprehensive, dealing with irrigation, soils, manure, the sugar-cane plant, tillage, diseases, harvesting, and even book-keeping and accounts. Some comparison between the cultivation of the cane in other parts of the world would have given the book more general interest. Even in the table giving Java's annual output of sugar the only comparable statistics are those of British India and Cuba. These countries with Java account for only about 65 per cent. of the world's cane sugar. At the end of last century the export of Java sugar was mainly to Europe, America (U.S.A.), and China. The American market has been lost. The principal export is now to Europe, China, Japan, and British India, but the Malay States and Australia also take considerable quantities. The total production of Java does not, like that of Cuba, show a material increase, although on the whole it has been higher since the war. Considering the great importance of this industry in Java it is not a little surprising to realize that only about one-eightieth of the island is under sugar. The volume is well produced and illustrated, and should be a useful guide to practical cane-growers.

R. N. R. B.

Adventures in the Near East, 1918–1922.— A. Rawlinson, C.M.G., C.B.E., D.S.O. London: A. Melrose. 1923. 9 × 5½, pp. xx. + 377. *Illustrations.* 25*s. net.*

Each of the three sections of Colonel Rawlinson's book contains a distinct series of adventures, and each if possible more enthralling in its own way than the last. The first recounts his connection with General Dunsterville's "Hush-hush" force, and here the story verges upon the realm of comic opera, to plunge, almost without warning, into that of breathless adventure. When he arrived at Baku in August 1918, the situation was extraordinarily complicated. The town was threatened from the outside by the advance of the German-led Turkish Army, while within, the moderate Russians and Armenians, with the outward acquiescence of the Moslem population, had just overthrown a Bolshevist administration, and established the "Central Caspian Dictatorship." Colonel Rawlinson eventually became "Controller-General of the Ordnance" to this body, and played a noteworthy part in the otherwise feeble

resistance to the Turks. The strange story of these extraordinary days, vividly related, culminated in what must surely be one of the most daring escapes ever carried through successfully. This necessitated getting the steamer *Armenian*, manned mainly by Bolshevists and crammed with explosives, out of Baku harbour, through a naval cordon which registered seven direct hits on her superstructure.

After the Armistice, Colonel Rawlinson was employed on intelligence work in connection with the Turkish disarmament, and thus had ample opportunity to become acquainted with Georgia and Kurdistan, and to watch the growth of the Turkish Nationalist movement at close quarters. Unluckily for himself, his forecast of the failure of the Armistice proved only too correct, so that on arriving in Erzerum in the winter of 1921 as an unofficial intermediary between the British Government and the Kemalists, he found himself and his party almost immediately prisoners in Turkish hands. The story of their trials, supported throughout with indomitable spirit, is the most compelling in a book packed with high deeds. Upon every page there is the imprint of an original, many-sided, and forceful personality, itself after all the most interesting study in this unconventionally written book.

A Servant of Sahibs.— Ghulam Rassul Galwan, Aksakal of Leh. Cambridge: W. Heffer & Sons, Ltd. 1923. $8\frac{1}{2} \times 5\frac{1}{2}$, pp. xvi. + 282. *Portrait.* 9*s. net.*

This is a book of a most unusual type, but is very refreshing for old travellers with experience of Ladak and Central Asian travel. The author is really a most remarkable and also a most attractive man. He has done firstrate work though rising from a humble origin. It appears that his grandfather followed the not altogether reputable trade of a robber, and from that profession the family takes its name. He must, however, have been an extremely amiable robber, and certainly his grandson has the most amiable qualities. As a servant he has covered a wide area of Central Asia, and has accompanied most of the better-known travellers in the 'eighties and 'nineties and early years of the present century. His account of his life and of his early doings is most clearly and intimately put down. He is a real diarist. I cannot, however, quite agree with him when he says that the book is a book to be read aloud, as the reviewer found it fascinating to read to himself. Rassul Galwan is of a mixed race. I see in the foreword that he is supposed to be of partial Pathan descent. He is probably therefore descended from certain Kashmir settlers who are referred to always in Kashmir as Kyberis, but I am afraid his face is rather typically Kashmiri, although of the most agreeable type.

One of the pleasantest sides of the book is its testimony to the affection the author has for all his different employers, and his references to them are very characteristic and attractive; the remark "as much I tell him sweet words, so much he abuse me" is extremely characteristic.

Of his many adventurous journeys, I think the hardest must have been when he accompanied Church and Phelps in their attempt to cross the Mustagh Pass on to the Baltoro Glacier. I cannot see, though I am not quite certain, why he should not have seen K_2 on that journey, nor do I see why the mountain pointed out by the Baltis as Masherbrum need have been any other mountain, as Masherbrum is some 25,000 feet high and lies more or less opposite the Mustagh Glacier, leading to the Mustagh Pass but on the south side of the Baltoro Glacier.

Later on his references to the British Joint Commissioner as B. J. C. are

extremely modern, and remind one of the universal habit which has been growing up since the war of referring to nearly every occupation by letters.

It is evident that Rassul Galwan is a man of exceptional character in every way, and now in his present position as Aksakal of Leh he is no doubt a very great influence for good, for, notwithstanding his many references to his little slips into "lie matter," he is evidently a man of the greatest integrity. The book itself is to be commended to all travellers in the East, especially to younger travellers, as giving them a quite exceptional insight into the workings of the minds of their subordinates; for this remarkable diary very clearly shows how their little doubts and fears and difficulties can be met, if treated sympathetically.

C. G. B.

Indian Engineering relating to Irrigation, Water Supply of Towns, Roads, and Buildings.— W. L. Strange. London: G. Routledge & Sons, Ltd. 1923. 9 × 5½, pp. viii. + 214. *12s. 6d. net.*

Mr. Strange is no new author; he commenced with a paper on earthen dams for reservoirs contributed to the Institution of Civil Engineers, for which he was awarded a Telford Premium. The subject was one with which Mr. Strange, as an engineer in the Bombay Deccan, was very familiar. The paper was an excellent one, and it met so decided a want that he subsequently dealt with the same question in all its bearings in book form. The book was still more successful than the paper. It was published at a time when the stimulus of the Irrigation Commission of 1903 was leading to the preparation of a large number of reservoir schemes, and in that direction there had been no previous publication of equal value. The work had a cordial reception, and it led to a much more ambitious venture. The sense of acquisitiveness makes a man a collector, and Mr. Strange is a born collector—of information. In the course of his career in Sind and the Deccan, in the secretariat of the Government of India, in the Transvaal where he was Director of Irrigation for five years, and in Ceylon where he was deputed to advise on irrigation policy, he was always collecting. He collected his own notes on his practical experiences, the notes of others, papers and reports, until he was saturated with information, and he then embarked on his important work, 'Irrigation, Roads and Buildings, and the Water Supply of Towns,' published in 1920. It was a work of immense labour, and, Mr. Strange being an irrigation engineer, irrigation questions occupy the bulk of the pages, but as engineers in the Bombay Presidency have duties in connection with water supplies and roads and buildings, these subjects are treated, though in a less comprehensive way.

Mr. Strange's latest book, with which we are now concerned, has almost the same title as that of the work which preceded it, but except in title there is little similarity. The chapters more resemble a series of lectures such as a professor might deliver to students to supplement their technical training, and in them the author has dealt with general principles, and not with mathematical formulæ or structural considerations. In that way the book has an aspect of a novel kind, and while it should be useful to engineers, inasmuch as principles are of equal importance with technical equipment, it might also be useful to laymen, and therefore be of wider service. It deals mainly with irrigation (which includes storage reservoirs), canals, the physics of great alluvial rivers, river embankments, flood discharges, hydrographic surveys, and other things. The parts on roads and buildings are confined to lines of communication in rural tracts and to buildings in outlying places. Mr. Strange is a keen observer as well as an engineer, and others besides engineers will be

able to appreciate the thoughts he has expressed after some forty years of active service. L. J.

Through Formosa : an Account of Japan's Island Colony.— **Owen Rutter.** London : T. Fisher Unwin. 1923. 9 × 6, pp. 288. *Sketch-map and Illustrations.* 15*s. net.*

We have a both valuable and entertaining book in Mr. Rutter's ' Through Formosa.' To a certain degree Mr. Rutter was personally conducted, for the island is so " officialized " that it is difficult to travel in any other way. But Mr. Rutter is a keen and sympathetic observer, a philosophic traveller, and a diligent collector of facts, and the result is a book which combines useful information and sound common sense with a great deal of humour and entertainment. The picture drawn of the " A.D.C." with whose opening greeting the book begins, " I am sent by the Governor-General to be your attaché," and of whom Mr. Rutter's penultimate tribute closes, " we felt that we had parted from a friend," is a most pleasing one. Few features of interest in the part of the island traversed by the writer escaped his notice, for he is a trained observer, and has been a sympathetic administrator of experience under somewhat similar conditions among a far Eastern folk still living in the childhood of their race in British North Borneo. For that reason his comments and criticisms as to the Japanese management of their island colony are of considerable value and authority.

The early history of Formosa under the influence of the Spanish, Dutch, and Chinese is graphically described, and excellent accounts are given of its agricultural wealth, and its general development under the Japanese. Whilst admitting freely that " the Japanese have met with extraordinary success in every commercial, industrial, economic, and scientific enterprise they have undertaken in Formosa," he holds that they " have failed in this one essential thing, the settlement of the native population." The reason for this he believes to be " lack of sympathy," of which virtue they have underestimated the importance, not realizing that they had so much to learn as to the wisest and most effective way of dealing with a primitive people whom oppression had rendered intractable and truculent. The Japanese have undoubtedly, as in Korea, exhibited a severity and, at times, a harshness amounting to cruelty, in dealing with a subject race ; but in criticizing this one should recollect that such severity has often been dealt out to *their own* people in the past under the stern centuries of feudal discipline, and it would seem only fair to judge them accordingly. The harshness cannot be condoned, though these facts serve to explain it more clearly.

A more intimate acquaintance with Japan and the Japanese would help the author to avoid some of the slips that might with advantage be corrected in future editions, and which are solely due to want of familiarity with such details. The Japanese do not " squat cross-legged " as many Asiatics do ; they kneel down and sit back on their heels, a position which largely accounts for the shortness of leg which is one of their special physical characteristics, now, however, beginning to disappear as the schools provide pupils with benches and chairs in place of matted floors. Again, the majority of Japanese able to afford and to obtain Western food cannot be said to " dislike it intensely," if one is to judge by the extraordinary popularity of the good restaurants in Tokyo and elsewhere, such as the Toyoken, etc. The highest mountain in Formosa, known to Europe as Mt. Morrison, was not named by the Japanese Niitaka after the late Emperor, whose personal name was Mutsuhito, changed posthumously to Meiji. The title, which means " The *new* lofty peak," was

intended to distinguish it as now the highest mountain in the Empire since it overtops even Fuji itself by several hundred feet. Fuji had hitherto been—as its name implies—the "Matchless" peak of Japan.

As one closes this agreeable and interesting book it is a pleasure to note the writer's appreciation of the kindly courtesy shown in furthering his desires to see as much as might reasonably be expected on the part of a people in whose official attitude of mind a certain atmosphere of hesitation and suspicion are inborn as a result of the past centuries of internecine strife and jealousy between the clans of feudal Japan. The clear outline map and the admirable photographs add greatly to the usefulness and attractiveness of a book which deserves a wide cirulation. W. W.

AFRICA

A Vision of Morocco, the Far West of Islam.— V. C. Scott O'Connor. London: Thornton Butterworth. 1923. 9 × 5½, pp. 382. *Illustrations.* 25*s. net.*

Old Morocco and the Forbidden Atlas.— C. E. Andrews. London: Hurst & Blackett. 1923. 8½ × 5½, pp. xx. + 296. *Illustrations.* 15*s. net.*

Both Mr. O'Connor and Mr. Andrews are at pains to impress upon us the impulsiveness of their decision to visit Morocco—in search of beauty and romance. Yet, from the telling, Mr. O'Connor's travels at least would seem to have been rather carefully planned. Through introductions obtained beforehand, he was able to make the acquaintance of several of the more important figures in French officialdom and in native circles. His account of the French and their colonial system is introduced by, and intermingled with, much of that type of highly wrought and lavishly coloured descriptive writing to which a subject such as Morocco lends itself. The strange medley of races in the towns, Arabs, Berbers, Jews, Negroes, with their distinctive traits, the profusion of mosques, palaces, and castles, witness to the varied and troubled history of this bridgehead between Europe and Africa, and in contrast, the encircling deserts and mountains, are described with a wealth of detail, whose culminating effect upon the reader is almost bewildering. Mr. O'Connor left few places in Morocco unvisited. Landing at Casablanca, the gate through which France also entered, he wandered wide: Fez, Marrakesh, Tangier, Agadir, Ceuta, Shishawen, found a place in his itinerary, and the historical associations of each are carefully noted. Marshal Lyautey received him, to speak broadly of French achievements and aims, and to win something approaching hero-worship in return. The logical, efficient system is described with warm approval, but in the background there seems to be the feeling that this new culture, with its set of values as alien as its accompanying 'planes, motors, cinemas, and cafés, is not yet deeply rooted—though after sixteen years it is hardly yet time to judge.

Mr. Andrews' is a plain, straightforward tale, concerned more with native life and the adventures of the road. He likewise landed at Casablanca, but a stay of a few days soon convinced him that he had not yet escaped from Western civilization. He journeyed on to Marrakesh; here too the sights palled in a while, so that the opportunity to accompany a French trader to the "forbidden" Sus was eagerly seized. Sus lies beyond the French sphere, but its patriarchal tribes and their feudal brigand barons seem resigned to what they regard as the inevitable French occupation. After an imprisonment of eight days at Auluz, the two adventurers had perforce to return. A feature of the narrative is the inclusion of translations of Berber and Arabic love-poems,

ballads, and folk-tales. Yet, despite his adventures, Mr. Andrews almost admits defeat. "Strange," he exclaims, "that romance should always be somewhere else!" Yes, but understandable, perhaps, when towns such as Rabat have to-day their "Comité d'Initiative et de Tourisme."

AMERICA

Menzies' Journal of Vancouver's Voyage.— April to October, 1792. Edited with Botanical and Ethnological Notes by **W. C. F. Newcombe,** and a Biographical Note by **J. Forsyth.** Archives of British Columbia, Memoir No. V. Victoria, B.C.: Provincial Library. 1923. 9½ × 6, pp. xii. and 172. *Maps and Illustrations.*

This work forms the fifth of a series of memoirs issued occasionally by the Provincial Archives Department, relating to the history of British Columbia, and largely based upon the considerable stores of unpublished material at its disposal. Although the present memoir is primarily concerned with the botany of Vancouver Island and Puget Sound, it is also of great geographical interest.

It reproduces, verbatim, a portion (April–October 1792) of the MS. journal kept by Archibald Menzies, the botanist who accompanied Vancouver during his famous voyage of discovery on the north-west coast of America in 1791–95. The original manuscript is in the British Museum, and has hitherto remained unpublished, although a transcript, upon which the present work is based, was executed some years ago for the Department.

Menzies, who was one of Sir Joseph Banks' numerous *protégés*, and had previously been round the world with Colnett in addition to acting as surgeon in several of H.M. ships, showed himself on the present voyage both a zealous and accurate botanist and a skilful surgeon. Although appointed for botanical work only, he took the place of the *Discovery's* surgeon when the latter was invalided, and had the satisfaction of paying the ship off after her four years' cruise without having lost one man through ill-health. His services were justly commended by Vancouver in his (posthumously) published journal, although it is evident, both from that and from the unpublished portion of Menzies' journal, that there was considerable friction between the pair—a regrettable consequence, in all probability, of the dislike felt for Vancouver by Banks.

The portion of the journal now published contains very interesting geographical, botanical, and ethnographical observations relating to the shores of Puget Sound and Vancouver Island, and has been edited in a most scholarly and complete manner by Dr. C. F. Newcombe. The spelling of the original is retained, and the pagination indicated. Explanatory notes have been added in the margin. The illustrations include portions of two of Vancouver's charts, and several engravings illustrating plants discovered by Menzies, some of which are from his own drawings. A list of his botanical discoveries is given in an appendix, together with a good bibliography.

The value of the memoir is enhanced by a short biography of Menzies from the pen of Mr. John Forsyth, the Archivist, illustrated by several photographs, etc., of historical interest. R. T. G.

AUSTRALASIA AND PACIFIC ISLANDS

The Naturalisation of Animals and Plants in New Zealand.— **Hon. G. M. Thomson.** Cambridge: University Press. 1922. 9½ × 6½, pp. 608. £2 2*s*.

In his exhaustive examination of the changes which man has effected in the fauna and flora of New Zealand, Mr. Thomson has produced a work of great

value both from biological and practical standpoints. The labour of the compilation must have been considerable in spite of the relatively short history of New Zealand, for there was a great burst of attempts at acclimatizing in the 'sixties and 'seventies of last century. With a view to getting game, familiar birds, and well-known flowers from the homeland, the settlers of those days introduced many species, and not always with success. As often as not the records of these attempts were lost or, if made, have proved difficult to trace. But Mr. Thomson is to be congratulated on his success in tracing the history and extent of naturalization of practically every alien species of animal and plant. He believes that on the whole more harm than good has been done to New Zealand by reckless and uncontrolled introduction of species, and rightly maintains that a national policy in regard to this matter should be formulated without delay. It is always dangerous to interfere with the balance of nature, and even apparently beneficial introduction may lead to grave results. The curse of the rabbit is of course a familiar example. In regard to this it is curious to learn that the earliest attempts to introduce rabbits were unsuccessful, and it was not until grey rabbits were introduced in the 'sixties of last century that the species spread widely. Many migratory birds of the British Isles have failed to thrive in New Zealand, *e.g.* the blackcap, nightingale, brambling, and Brent goose, no doubt because in trying to migrate they are lost at sea. All attempts to stock rivers with the Atlantic salmon have been fruitless. During half a century millions of young have been liberated in the rivers. They descend to the sea but not one ever returns. The lobster and the crab are other notable failures. In one respect this scholarly work might be made of more geographical value. It would be of interest to know what, if any, success has been reached with alien species from a climate widely different from that of New Zealand. The success of species from the British Isles and from parts of Australia throws no light on the general problem of the possibility of acclimatization. No doubt the information indicated could be found by searching the records of individual species, but we would like to see it collected and discussed in a short chapter. The book concludes with a long bibliography and very full indices. R. N. R. B.

POLAR REGIONS

British (Terra Nova) Antarctic Expedition, 1910–1913. Glaciology.— C. S. Wright and R. E. Priestley. London : Harrison & Sons. 1922. $12\frac{1}{2} \times 9\frac{1}{2}$, pp. xx. + 582. 179 *Text Figures*, 291 *Plates*, *and* 14 *Maps*.

The publication of the memoirs of Captain Scott's last expedition, delayed for a time by the war, appears to be now nearly complete. The volumes already published have set a high standard of scholarship and research, and it is therefore no surprise to find that the present one makes a worthy successor to the work of Dr. Simpson and others. Its interest and usefulness to geographers and glaciologists are beyond question. Not content with a purely descriptive memoir on their observations, the authors have also picked out the main problems for extended treatment, and faced issues which are not merely of Antarctic but of world-wide interest. Mr. Wright, for instance, devotes a chapter to the mechanism of glacier motion. The conflicting ideas are handled with clearness and moderation, but in the end the author expresses his preference for the view that glacier motion is most clearly understood and explained by one hypothesis. This supposes the occurrence of mobile molecules in a crystal lattice of immobile molecules, the number of mobile molecules being conditioned by the temperature of the ice. The discussion and application

of the hypothesis lead naturally to statements on glacier erosion, and it is interesting to note that the conservative views generally held by glaciologists who have worked in high latitudes are upheld by the present authors. They conclude that "up to certain critical speeds there is little erosion of the glacier bed. Above such speeds erosion becomes more and more significant, until the efficiency of glaciers as eroding agents becomes comparable with that of other geological forces. If we apply the principle to the Antarctic Continent—or rather to South Victoria Land—we are compelled to the conclusion that here the covering of the continent has to-day a predominantly conservative effect."

Of similar interest is Mr. Priestley's attempt to classify the diversity of glacier types which he saw and studied. He realizes the difficulty of such an attempt, and makes no claim, therefore, to finality, but it is significant that his grouping of types has a great deal in common with similar work by Dr. Otto Nordenskjöld. In this agreement may perhaps be seen a sign that the looseness of ideas in regard to glacier types is now almost at an end. Mr. Priestley bases his classification on the main factors which operate on a glacier at an advanced stage of a glacier cycle, namely, temperature, precipitation, slope, and denudation. The stage in the relief of the underlying land surface is given all consideration, but regarded as subordinate to these factors. The natural classification which results pictures a glacier in the full force of its manhood, nourished on a plateau, forcing its way to sea-level, and finally wasting away either as an ice-piedmont or as an ice-barrier. The types may be arbitrary, but their form, position and other characteristics enable them at any rate to be easily defined and easily recognized from definition.

In their Foreword the authors refer to the somewhat unusual form of the Report, and to its being the work of two writers, one a physicist, the other a geologist. The result must be to the mutual benefit of both the sciences concerned, and a joint authorship of this nature certainly gives point and emphasis to the conclusions drawn in the final chapter on past geological climates of the Antarctic and the causes of glacierization. The authors in this connection make the very decisive statement that "glacial conditions have been the exception and not the rule in Antarctica," and that a warm and temperate climate has been the normal situation.

It seems a pity that such a useful book has no index, though its place is partly taken by a full list of subheadings; the photographic plates have to be employed to trace down definitions, for example, névé. The total of photographs is nearly three hundred, and it is no exaggeration to say that they constitute the finest gallery of ice pictures in any English publication. Besides the authors' own plates, they include some of Mr. Ponting's best work and views taken by Mr. Debenham and Dr. Levick.

Apart from the lack of index there is one other serious defect. The references in the footnotes are in such an abbreviated form that their value is almost negative. A paper is mentioned, but the transaction in which it appears omitted; and authors are quoted or paraphrased, but in most cases without the page reference which a student so often requires. The result is very exasperating to any one seriously interested in the subject, and will almost certainly detract from the ultimate value of the memoir.

J. M. W.

GENERAL

Palestine and Morocco.— Sir W. Martin Conway. London: Edward Arnold & Co. 1923. 9 × 6, pp. viii. + 296. *Illustrations.* 16*s. net.*

In this delightfully written volume the author threads together into one the problem of these two lands under the subtitle 'Lands of the Overlap.' He

clearly shows how much may be learnt from the French methods of dealing with their special problems in Morocco, which may be of assistance in the even more complicated situation which the British Government has to face under the mandate for Palestine. France has made one experiment in Algeria; she is in Morocco now engaged in trying another. This latter policy is rather to develop and foster the Sherifian Government and the native art and civilization than to replace them, as she has so largely done in Algeria. Britain has had long experience in Egypt, but that is not enough for meeting the peculiar difficulties of Palestine. It is unfortunate that the author with his powers of acute observation did not round off his journey by a study of the methods of the French—yesterday and to-day—in Syria. The impact of the West, which "lives by change," with the East, that "desires no change at all," raises problems of immense complexity. The author thoroughly appreciates the Eastern spirit—for the Oriental. With many another traveller he sadly bewails the change which the last thirty or forty years have made in Cairo and Constantinople.

"The main mistake England has made in her treatment of Orientals is that she has tried to endow them with her own kind of education and thus to adapt them to assume political institutions which are essentially Western in origin and spirit. We have taught our language, our laws, our social and political notions to the young men of wholly alien races. We have attempted to give to the people of Islam and other religions a polity shaped and developed by Christianity through nearly two thousand years. We have put them into our ready-made clothes, which neither fit them nor are adapted to their climate. . . . Instead of impressing them with our power and wisdom, we reveal to them our vast imperfections. . . . The French are going to make no corresponding mistake in Morocco."

In the Morocco section of the book Sir Martin Conway gives delightful pen sketches of Marrakesh, Rabat, Meknes, and Fez. He has much to say of the admirable work of Marshal Lyautey. The chapter on Franco-Moorish Architecture is particularly interesting. Of Palestine itself the author writes in places in glowing terms. Witness his account of "mediæval Jerusalem," "a treasure beyond price," of the Dome of the Rock, and most of all of that "delightful spot on the Lake of Galilee, Tabgha"—of which he says, in our opinion, not a word too much.

On the urgent political problems of Palestine to-day Sir Martin Conway has clearly justified the present British Administration's attitude. Palestine cannot be wholly Arab—it must be an open gate; it cannot be wholly Jewish, such a state could not exist without unending military protection as an islet in the midst of Arab land. "The policy of the Balfour declaration which has been adopted by the world, involves the maintenance in Palestine of an impartial outside authority, neither Arab nor Jewish, and that for a period of time longer than it is now possible to estimate. It is obvious that from the point of view of British interests that authority must be British." Those who doubt this conclusion would be wise to study this volume.

E. W. G. M.

Economic Geography.— John McFarlane. 2nd edition. Revised and enlarged. London: Sir I. Pitman & Sons, Ltd. 23. $8\frac{1}{2} \times 5\frac{1}{2}$, pp. viii. + 640. *Maps.* 10*s.* 6*d. net.*

The first edition of this comprehensive text-book was published in 1914. The three opening chapters dealing with the general factors have been ex-

panded, and others re-written. Most of the modifications suggested in the review of the first edition in the *Journal* seem to have been adopted. Though the work is based upon the study of natural regions, for obvious reasons account has been taken of recent political changes, down to the Treaty of Lausanne, whose territorial provisions are indicated in a footnote.

The great obstacle, however, to the complete revision of a work of this character is the present position of international trade. Mr. McFarlane's practice is to give a summary of the position in 1914, and then to show briefly those recent tendencies which seem likely to be permanent. The statistics of British trade show the average value for the years 1909–13, but, to afford some basis of comparison, the volume of trade for the years 1913, 1921–22 is given. Similarly, the quantity of German trade for the first half of 1922 is shown. In the case of Russia, of course, the commercial position is even less definitely indicated.

Nouvelle Géographie Universelle : le monde nouveau ; les aspects de la nature, les ressources agricoles industrielles, la vie des hommes.— E. Granger. Paris : Hachette. 1922. 2 vols. 12½ × 9½. Pp. 476 and 496. *Maps and Illustrations.* 150 *frs., bound.*

The publication of a work of this nature, full, accurate, superbly illustrated and beautifully produced, says a great deal for the interest felt in France for geographical matters. It is doubtful if any publisher in this country would dare to launch such a publication with any hope of sales numerous enough to cover the cost, let alone leave a margin of profit. This work is popular in the best sense of the word, but it is not " written down " to mediocre intelligence. No mere snippets of description and history, but a logical account of the physical, economic and human aspects of every land, with the geographical standpoint always in evidence. Some of the sections on the distribution and occupation of the people are particularly valuable and worthy of the attention of serious geographers. Abundant statistics are given, in most cases for 1919 and 1920 as well as 1912 and 1913. French possessions are treated most fully, but the balance is well kept throughout, the only exception being the scanty treatment of polar regions. Prof. Granger has produced a comprehensive work of reference which at the same time is readable from cover to cover. In a work of this scope minor mistakes are bound to occur. Easter Island does not belong to the United States ; Tristan da Cunha is not uninhabited ; and the archipelago of Spitsbergen is not built of gneiss and granite. There are no walrus at South Georgia and the Falkland Islands. The maps include thirty-two in colour and over 120 in black and white. All are excellent specimens of cartographic skill and careful printing. But the lack of an index is a serious blemish in a book of this nature. R. N. R. B.

In the February number of the *Journal* we reviewed briefly the book 'The World as Seen by Me,' recently written by Mr. T. Simpson Carson, a Fellow of the Society, and published by Messrs. Heath Cranton, Ltd. We have now received from the Reverend Frederick Brown, Chaplain to the Guards' Depôt, Caterham, and also a Fellow of the Society, a letter calling attention to a passage in Mr. Carson's book which makes an entirely false and unfounded criticism of Mr. Brown's conduct at the relief of the Legations in Peking. Mr. Carson has now apologized and withdrawn this imputation, and has paid a sum in damages which Mr. Brown is handing to Missions in China, and the publishers have withdrawn the book in order that the offending passage may be blocked out.

THE MONTHLY RECORD

THE SOCIETY

Medals and other Awards for 1924.

THE King has approved the award of the Royal Medals of the Society as follows: The *Founder's Medal* to Ahmed Hassanein Bey. for his journey in 1923 to Kufara and Darfur; the *Patron's Medal* to Commander Frank Wild, for his long services to Antarctic Exploration. The Council have awarded: The *Victoria Medal* to Mr. J. F. Hayford, formerly of the United States Coast and Geodetic Survey, for his establishment of the theory of Isostasy; the *Murchison Grant* to Mr. J. H. Reynolds, for his work on the 1/Million map and for the Permanent Committee on Geographical Names; the *Back Grant* to Mr. M. C. Lester, for his geographical work in Graham Land; the *Cuthbert Peek Grant* to Mr. F. Kingdon Ward, to assist him in his present journey in Tibet; the *Gill Memorial* to Major A. L. Holt, for his Surveys in Arabia.

EUROPE

Fiume.

Under the terms of the Treaty of Rapallo, 1920, between Italy and the Kingdom of the Serbs, Croats, and Slovenes, the city of Fiume, with a strip of surrounding territory, was constituted an independent state. For various reasons this settlement proved unworkable. In the recent treaty between the above two States, signed at Rome on January 27, another solution has been adopted. Italian sovereignty is recognized over the port and city of Fiume and the adjacent territory, the boundaries of which are to be determined by a Mixed Commission on the general lines laid down in the Treaty. In return, Yugo-Slav sovereignty is recognized over Porto Baros and the "Delta." The boundaries between Porto Baros and Fiume are to be established as shown in the plan attached to the Treaty of Rapallo. Italy is to lease to Yugo-Slavia for fifty years at a nominal rent the basin in the Port known as Thaon di Reval. The status of the railway station is to be the same as that of other international stations on the Italian frontier. Yugo-Slavia is to enjoy the full sovereignty of the Fiumara Canal. The Delta and Porto Baros were handed over to the Yugo-Slav authorities on February 24. The reorganization of the railway system is now in progress, and a regular passenger and goods service is running between Fiume and Agram in Croatia. Under the arrangements thus made for Yugo-Slavia to share in the harbour facilities, Fiume should prove an important outlet for Central European commerce. Without such traffic, its value to Italy cannot be great.

ASIA

The Death of General Pereira.

We have received some further details of the death of Brigadier-General Pereira in Kangse, Szechwan, which supplement the obituary notice in the *Journal*, **63**, p. 87. It is thought that General Pereira intended to work his way through the territory of the Goloks, which, with the Heh Shui country, remains one of the least-known areas on the Tibetan frontier. The actual details of this journey he kept to himself, but it is known that his objective was Lanchowfu in Kansu. He was accompanied by Dr. H. G. Thompson. After having been unwell for some days, the General collapsed on his way beyond Tatsienlu; with difficulty Kangse was reached, where he died on the

morning of October 20 last. On this last journey he had met with considerable obstacles. At one stage it was only by giving Chinese officials a written statement absolving them from all blame should anything happen to him, that he was allowed to proceed.

AFRICA

The Tangier Convention.

The convention signed in Paris on December 18 by representatives of Great Britain, France, and Spain is designed to secure the permanent neutrality of the port of Tangier, and economic equality for all Powers using it. This has been accomplished mainly by the creation of an international administration, which will also replace the system of capitulations. The autonomy of the zone is not in any way to usurp the sovereignty of the Sultan of Morocco, whose authority over his Moorish subjects in Tangier remains untouched. He will be represented by a *Mendub*, who will be responsible for the native administration and the collection of taxes. The international authority will be embodied in the Committee of Control and the International Legislative Assembly. The committee, consisting of the consular officers of the eight Powers, signatories of the Act of Algeciras, will see that the terms of the Statute are carried out. The International Legislative Assembly, of twenty-six members (among them nine natives) will legislate for the whole population, and will make nominations to all administrative posts. At the outset the Administrator will be a Frenchman, in order to ensure co-operation with the French Moroccan Protectorate during the transition. To secure genuine international equality, the working of the port will be supervised by a committee appointed by the Committee of Control, which will also watch the Customs service. The construction of the port is to be put up to public tender, but the concession for working the port has been granted to an international company, "Société du port de Tangier," for sixty-seven years. In this company France will have a larger share than other nations. The share capital is at present fixed at 7½ million francs. The actual cost of construction of the port will be met by a loan guaranteed by the Protectorate of Morocco. The plans for the port include two breakwaters of 960 and 650 metres respectively, and an outer harbour for ocean vessels, 35 acres in extent. It is expected that the scheme will be completed in five years.

M. Bruneau de Laborie's Journeys in Northern Africa.

The Société de Géographie de France of Paris has awarded its Gold Medal to M. Bruneau de Laborie for two journeys across the Sahara. For the purpose of investigating the economic possibilities of the region east and south of Lake Chad, he travelled in 1921 through Dahomey to Kano in Nigeria, then on, through the northern Cameroons, to Fort Archambault. After examining the basin of the Shari and the Wadai region, he returned from Abeshr north of Lake Chad to Zinder. The last stage of the journey was across the Sahara to Algiers, *viâ* Aïr and Ahaggar. A note on the results of this journey appeared in the *Journal*, vol. **61**, p. 224. At the end of 1922, M. de Laborie was again entrusted with a mission to the French Cameroons and Central Africa on behalf of the Colonial Ministry and the Natural History Museum. On its completion, he was asked by the Société de Géographie to attempt the journey from Lake Chad to Alexandria across the Libyan desert. This task M. de Laborie accomplished successfully, travelling by way of Borku, Tibesti, and Kufara. He delivered a lecture to the Société upon the expedition on March 11. Among former recipients of the medal were René

Caillié (who in 1828 first crossed the Sahara from Timbuktu to Morocco), Stanley, Livingstone, Marchand, Lyautey, and Shackleton.

The Navigation of the Kariba Gorge on the Zambezi.

There appears to be a tendency among present-day residents in Rhodesia to overlook the fact that the savage gorge on the middle Zambezi, generally known as Kariba (though this is a generic term rather than a proper name), where the river passes by furious rapids through a passage only some 60 yards wide, was successfully navigated by members of the late Colonel Gibbons' expedition in January 1899. It is therefore, perhaps, desirable to recall the circumstances of this achievement, which has apparently not been repeated. Major Gibbons (as he then was) took with him, it will be remembered, a small aluminium steamer—the *Constance*—capable of being transported overland in sections, which was the first to navigate the middle Zambezi above the Kebra-basa rapids. During the ascent of the river in 1898, Major Gibbons found the Nakabila rapids in the Kariba above the Sanyati confluence too dangerous to justify the attempt to navigate them, and the steamer was therefore transported overland. In December the *Constance* was sent back downstream in charge of Mr. Weller, the capable engineer whose skill had overcome so many obstacles during the upward voyage (his only white companion being the medical officer, Mr. C. J. Smith), and it was decided to attempt the passage of the gorge. The river was now high, and deep channels therefore existed among the rocks which encumbered the bed at low water, but the strength of the current was correspondingly increased. Dr. Smith sends us some reminiscences of the hazardous venture, which was accomplished without mishap. It was, he says, a weird run, rocks all over the place, the torrent curving and twisting about, sometimes almost at right angles, with only a very narrow path in which to keep the vessel, yet strangely dark and wickedly smooth, with whirlpools in miniature. Once or twice the boat was nearly out of hand, and it was only by perpetually "joggling" the tiller that it was possible to keep clear of the dangerous boulders.

AMERICA

Cession of Territory by Panama to the United States.

Through the courtesy of the Foreign Office, we have received a cutting from the Panama *Star and Herald* of 7 February 1924, dealing with a cession by Panama of 22 sq. miles of land to the United States. The land is in the districts of San Juan de Pequeni and El Vigia, round the headwaters of the Chagres River. Its acquisition was rendered necessary by the intention of the United States to construct a dam across the Chagres in this neighbourhood in order to form another reservoir which will ensure an adequate supply of water at all times for the operation of the canal. The inhabitants of the district were removed to Gatuncillo, near Gamboa.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Surface Polygons and their Origin.

Mr. N. E. Odell, joint author with Mr. J. S. Huxley of the paper on "Surface Markings in Spitsbergen" printed in the March number of the *Journal*, sends us the following note on an allied phenomenon observed in a mountainous region.

La Géographie for April 1923 contains an interesting article by M. André Allix on his observations in the French Alps of those curious surface polygons,

usually outlined with stones, to be found chiefly in arctic and sub-arctic regions, whose origin is due to long-continued alternations of freezing and thawing. The arctic occurrences have been described by several writers, and notably so by Bertil, Högbom and Nansen, but little has as yet been said concerning the forms to be found in alpine regions, owing no doubt to their rarity.

Very rightly does M. Allix at the outset carefully distinguish between the two main types of polygonal markings, so often confused, namely, (1) those delimited by stone borders and containing mud centres, *i.e.* "stone-polygons"; and (2) those occurring in mud and separated by cracks, best called "fissure-polygons." It is the first type that has been found in the French Alps in the Briançon district. On a rock island formed of slate, in the glacier of Mont-de-Lans en Oisans, at an altitude of 3402 metres, there is a well-developed network of polygons. The individuals of the system are of smaller size (50 to 75 cms. diameter) than the usual arctic examples, yet the characteristic mud centres, with stones arranged on the periphery at right angles to radii, are well represented. The nature of the sub-strata was apparently examined by excavation, and it is interesting to note the discovery of the frozen state of the mud centre and the depth to which it extends. These observations, as far as they go, agree fairly well with those of Mr. J. S. Huxley and the present writer made in Spitsbergen, where we have excavated several types of polygons. But what is not made clear is the depth of the frozen sub-soil. This is nearly always found in the Arctic at depths which vary according to the season, and it is an important factor in the mechanism of the polygon, since in its surface small gutters are formed beneath the stone borders which afford a means of drainage, and thereby retard comminution. M. Allix appears to have found a frozen mud "plug" at the centres of his polygons extending to the maximum depth excavated of 75 to 100 cms. It would have been interesting if he had ascertained whether this plug were continuous with any frozen sub-soil or ground-ice, or if there were only a solid rock bottom close at hand. The question of the size of the polygons is dealt with below.

M. Allix also mentions another type of polygonal marking, occurring on a rounded summit of crystalline schist, called Roche-Mantel, in the vicinity of that cited above. This was bordered by larger stones, which seemed to be disposed according to size. But the important fact is that the central portion of this type of polygon was of ice or congealed snow, in the form of a column 20 to 30 cms. in diameter which was found to reach a depth of 75 to 100 cms. M. Allix refers to the work of Leffingwell in Northern Alaska and the conclusions he arrived at as to the presence of localized wedges of ground-ice causing by their growth compression of the associated soil. He considers it highly probable that the centres of the polygons may be identified with such ice-wedges, the circumferential arrangement of the stones being an effect of the expansion and compression of the ice with variations of the temperature. The author here again does not make it quite clear whether the frozen centres are composed wholly or mainly of pure ice, or of ice with soil inclusions, or only of wet soil frozen hard. Apart from the rather sweeping conclusions drawn by Leffingwell as to the local occurrence, and the processes arising from the presence, of ice masses, our own observations on similar types of stone-polygons do not allow of such ice masses being considered the initial cause of the genetic process involved. Rather we find, in agreement with Nansen, that the rock surface is at the outset differentially disintegrated by repeated freezings and thawings ("nivation" effect). Then, as postulated by Högbom, those portions reduced to finely comminuted mud will become saturated with water from

melting snow, and consequent upon the action of successive freezings and thawings they will form the centrifugal centres of polygons. This in brief seems to be the *modus operandi* of stone-polygon formation. The idea of ice-wedges forming polygons from a solid rock surface seems to the present writer untenable, and it would appear that only under such conditions of tundra land as instanced by Leffingwell, where the soil is of a more yielding nature, could such action take place: this latter type moreover falls into the category of "fissure-polygons," mentioned earlier.

Much yet remains to be learnt concerning the genetic processes of these phenomena, and a great deal of light could be thrown on the subject by more thorough excavation, as well as experimentation, by observers able to remain in a productive region, or who revisit it frequently.

With regard to the small size of the stone polygons compared with those usually found under similar conditions in the Arctic, the present writer ventures to suggest that in low latitudes, owing to the more frequent changes in temperature brought about by the relatively rapid alternation of night and day, there will be a tendency for the formation of a larger number of centres of activity (by "nivation") at any one time. In high latitudes, on the other hand, the extreme changes in temperature are less frequent owing to the long diurnal and nocturnal periods, the process is slower, and centres first forming will get a start on others and tend to dominate them. The effect may perhaps be compared to the crystallization of a substance from solution as the cooling has proceeded more or less rapidly, smaller crystals forming in the former case, larger in the latter.

Finally, M. Allix describes and figures interesting cases from the same region exemplifying "solidification" and "nivation," which are undoubtedly important factors in the moulding of arctic, sub-arctic, or high alpine land-forms. Nevertheless he has not found that nivation has produced more than slight surface relief, and then only in soft and friable rock. Here again careful and extensive observation carried out over longer periods in the neighbourhood of the prevailing snowline in any given region, would enhance our knowledge of these and other allied processes, which are as yet little appreciated or understood.

In reference to the paper in the March number Mr. Huxley writes: "Since the paper was in proof my attention has been drawn by Prof. E. de Martonne to a paper and discussion by M. Longchambon and others to be found in the *Compte Rendu Sommaire, Soc. Géol. de la France*, for 16 December 1913, pp. 181–5. Longchambon attempts to explain the prismatic structure of basalt by means of convection currents and differential distribution of particles before solidification. Douvillé and Gentil drew attention to the analogy between the structure of prismatic basalt and that of stone-polygons; Longchambon agrees in believing that slow movements of convection are the prime cause determining stone-polygons. All however appear to think that these occur only in solifluctional streams of mixed material, mainly mud; and thus neglect the comminution effect, which, as has been shown in the body of our paper, is one of the main causes of stone-polygons' appearance, and may give rise to their occurrence at the surface of live rock."

GENERAL

The Ninth Italian Geographical Congress.

This Congress will take place this year at Genoa from the 22nd to the 30th April. Such meetings of Italian geographers, corresponding to the *Geogra-*

phentagen in Germany, were inaugurated in 1892 by an assembly in the same city of Genoa, summoned in order to commemorate the fourth centenary of the discovery of America. They have been held in various Italian cities, the last and in some ways the most successful having been in Florence in 1922. The present Congress is organized by the National Italian Geographical Committee, lately formed in affiliation with the International Geographical Union. Although it will lack the special importance of the Congress of 1892, it is thought that the present situation both in Europe and the Colonial world will give scope for much useful discussion on the part of geographers. Besides the general meetings, there will be meetings of six sections which are to deal with the several branches of the subject, and eight exhibitions are being organized, several of which will be specially concerned with Liguria under various aspects, physical and historical. Those devoted to Ligurian cartography and the work of the Genoese Cartographical School should be of special interest.

OBITUARY

The Rev. Prof. Thomas George Bonney, Sc.D., LL.D., F.R.S.

By the death of Dr. T. G. Bonney on 9 December 1923, at the age of ninety, the Society has been deprived of one of its oldest and most distinguished members, the range of whose activities was truly remarkable. It was as a geologist that he was most widely known. He was Secretary of the Geological Society from 1878 to 1884, and its President from 1884 to 1886, and received its highest award in 1889. He was also a Past President of the Mineralogical Society. He was almost as well known as a theologian. He was a preacher in the Chapel Royal at Whitehall from 1876 to 1878, Hulsean Lecturer at Cambridge in 1884, and delivered two series of Boyle Lectures in 1890–91 and 1891–92. For some time he was Examining Chaplain to the Bishop of Manchester, and he was an Honorary Canon of the Cathedral. For twenty years he held office, first as Dean and afterwards as Tutor, at St. John's College, Cambridge. For twenty-four years he was Professor of Geology at University College, London. He was Secretary of the British Association from 1881 to 1885, and many years afterwards, in 1910, he was its President. He was one of the pioneers in the explorations of the Alps, especially of the French Alps, and was a Past President of the Alpine Club. Less widely known is the fact that, in spite of his other occupations, he found time for eight years to be one of the regular writers for the *Standard*, joining the staff in the great days of that paper under the editorship of Mr. Mudford, of whose abilities he held a high opinion, and resigning in 1905 when he returned to Cambridge.

Dr. Bonney was born on 27 July 1833 at Rugeley, in Staffordshire, and he retained his affection for his birthplace throughout his life. At the age of eighty he told the writer that he had lived through eighty Christmases, and seventy-nine of them he had spent at Rugeley. A single Christmas he had passed abroad, when he was a young man. His father, who had been at Clare College, Cambridge, was master ot the Grammar School at Rugeley and perpetual curate of Pipe Ridware. For four years of his boyhood Dr. Bonney was at Uppingham. It was before the days of Thring, under the head-mastership of Henry Holden, and Dr. Bonney always felt that he owed much both to the head master and to his assistants. From Uppingham Dr. Bonney passed, in 1852, to St. John's College, Cambridge. He read for both the Mathematical

and the Classical Tripos, and in 1856 he took his degree, being twelfth Wrangler in the Mathematical tripos and obtaining a second class in the Classical Tripos. Amongst the other Wranglers in the same year may be noticed the names of Browne, afterwards Bishop of Bristol, who still survives, and Fawcett, afterwards Postmaster-General. For a short time after he took his degree Bonney was mathematical master at Westminster, but in 1859 he was elected to a Fellowship at St. John's and returned to Cambridge, where he remained till 1881. In 1861 he was made Dean, and a few years later Tutor. It was during this period that he first seriously took up the study of geology. Even as a boy he had been keenly interested in the subject, but while he was an undergraduate he had not found it possible to attend more than a few of Prof. Sedgwick's lectures. Now that Sedgwick was growing old a great deal of the geological teaching fell to Bonney's share, and many of the leading geologists of to-day owe their training to him. In 1877 Dr. Bonney was appointed Professor of Geology at University College, London. At first he still resided at Cambridge, but in 1881 he removed to London. He held the Professorship till 1901, when he retired with the title of Emeritus Professor. Four years later he returned to Cambridge, where he remained until his death. In this latter part of his life he accepted only honorary positions. But he found it impossible to refrain from teaching—it is sometimes rather tiring, he said in 1921, for a man born in 1833 to keep in touch with young men, but it is pleasant. Until a few months before his death he helped the Geological Department by giving informal assistance to the students in their practical work. Thus from 1869, when he first gave a course of lectures on geology, to 1923, with the exception of a break of about five years, he was engaged in teaching geology.

He was not robust—he once said that when he was a young man he never supposed for a moment that he would attain any great age—but when he was over eighty-five he could still enjoy an afternoon walk of six or seven miles, or spend the whole day geologizing; and it was one of the comforts of his old age that he never lost his appreciation of nature and the open air. Even till his last illness he kept up the habit of afternoon walks, though in the last two years of his life their length became more restricted.

The number of books and papers that he wrote was very great. He was one of the first in England to follow Sorby in his application of the microscope to the examination of rocks, and many of his scientific papers deal with petrological matters. He was especially interested in volcanoes and in the Alps, and besides his more strictly scientific papers on these subjects he wrote two volumes of a more popular character entitled 'Volcanoes' (1899) and 'The Building of the Alps' (1912). But perhaps it is his work on ice and the Glacial Period that is of most interest to geographers, and on this subject he wrote another semi-popular volume called 'Ice Work, Past and Present.' He was one of those who believed that the erosive powers of glaciers are very small. He was also definitely opposed to the idea that during the Glacial Period the north of Europe was covered by a great ice-sheet, and some of his latest papers deal with the evidence on this question. At the same time he was not a whole-hearted supporter of the alternative hypothesis of submergence. Summarizing his position very aptly in the course of conversation, he said that to judge from the evidence available both theories were improbable and the ice-sheet theory was impossible.

A prominent feature in his character, which appears in all his work, was his independence of thought. In geology, as far as possible, he made a point

of examining the evidence in the field and in the laboratory before he read the views of others upon the particular question under consideration. His own views, whether he was right or wrong, are always valuable. They express the opinion of an independent thinker, unaffected by the opinions of others, but necessarily influenced by the experience and habits of thought of the thinker himself. Perhaps he never realized how great the latter influence must always be.

A minor phase of his activity remains to be mentioned. In some of his earlier visits to the Alps he was accompanied by his friend Elijah Walton, the artist, of whom he always spoke with a sincere affection. He wrote the letterpress for several of the volumes of reproductions of Walton's water-colours which were published between 1867 and 1878. Perhaps it was Walton's influence that led him to devote a considerable amount of time to sketching in pencil, and in 1865 he published 'Outline Sketches in the High Alps of Dauphiné,' with reproductions of his own drawings. He continued to use the pencil freely till the end, and the note-books of his excursions are full of sketches to illustrate points of geological importance, but his interest in sketching for sketching's sake ceased with the death of Walton.

PHILIP LAKE.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1923–1924

Eighth Evening Meeting, 25 February 1924.—The President in the Chair.

ELECTIONS.—Webster E. Browning, PH.D., LL.D.; Paul Edmonds; Commr. William George Astell Ramsay Fairfax, C.M.G., D.S.O.; Robert Wren Foster; Arthur A. Haserick; Frank Oswald Laughland; Frederick John Parry Parker; Captain Richard Llewellyn Rees; Leonard C. F. Robson, F.S.A.A., F.C.I.S.; Miss Ellen May Sanders, PH.D; E. Stanley Sutton; Miss E. Sarah Wightman, LL.A.

Ninth Evening Meeting, 10 March 1924.—Colonel Sir Francis Younghusband, Vice-President, in the Chair.

ELECTIONS.—Miss Dorothy Denoran Adam; Norman Frank Burt; Rev. Harold Jocelyn Buxton; Lieut.-Commr. Waller Clark Clark-Hall, R.N. (rtd.); Charles Woide Godfrey, B.A.; Rev. C. H. D. Grimes, M.A.; Rev. William Moore Hardy, M.D.; Captain William John Keynes; Alfred Austin Lendon, M.D.; Miss Muriel Clarice Edith Long; Charles Andrew Sutherton Russ; John Elliott Stevenson; Robert Louis Stuart; Robert Wilberforce; Colonel W. E. Wilson-Johnston, C.I.E., C.B.E., D.S.O., I.A.

PAPER: Natural Resources in Relation to the Arts. C. E. N. Bromehead.

Fifth Afternoon Meeting, 17 March 1924.—The President in the Chair.

PAPER: Discussion on the choice of a Grid for British Maps, opened by Colonel J. St. J. L. Winterbotham.